POPULAR SCIENCE

MONTHLY

Mechanics & Handicraft

May 15¢

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DETROIT

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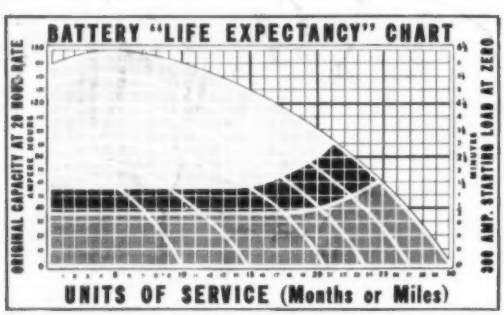
SEE PAGE 124

Half an hour late ALREADY!

Replace your battery BEFORE it breaks down—NOT AFTER


BATTERY "LIFE EXPECTANCY" CHART
ORIGINAL CAPACITY AT 20 HOUR RATE
AMPERE HOURS
300 AMP. STARTING LOAD AT ZERO
MINUTES
UNITS OF SERVICE (Months or Miles)

You know that feeling when you rush out to the car in a hurry to get to work—step on the starter—and nothing happens! Nearly everyone has experienced it at one time or another, because batteries *do wear out*. Developments and improvements during the last ten years have greatly extended their useful life, but the fact remains that no battery can last forever!

No one wants to waste money on a worthless battery, and no one wants to give up a battery that still has plenty of service left in it but is simply "run-down" because of improper generator adjustment or defective wiring. The Delco Battery "Life Expectancy" Chart was prepared with this in mind. It provides a check on your battery that will save you money and inconvenience!

The Delco Battery "Life Expectancy" Chart shows you how many months of service are left in your battery, based on its original capacity and the units of service it has given. The information for this chart was obtained after extensive research to determine the average life of various capacity batteries. Ask any Delco dealer to show it to you, and let him demonstrate how it works with your own battery. If you are interested in studying this chart, he will give you a miniature edition for your own use.

Unsolicited letters from car owners in every part of the country testify to the exceptional service received from Delco batteries. Outstanding dependability under all operating conditions explains why Delco batteries are standard on all General Motors cars and trucks.

Delco-Remy

ANDERSON, INDIANA

Delco battery sales and service requirements are available at United Motors Service Stations and dealers everywhere.

UNIT SER MO

World's Largest Manufacturer of Automotive Electrical Equi

Facts Show It— Owners Know It

PLYMOUTH IS THE MOST FOR LOW PRICE

STANDARD on "De Luxe" models—Perfected Remote Control Gear Shifting with Auto-Mesh Transmission.

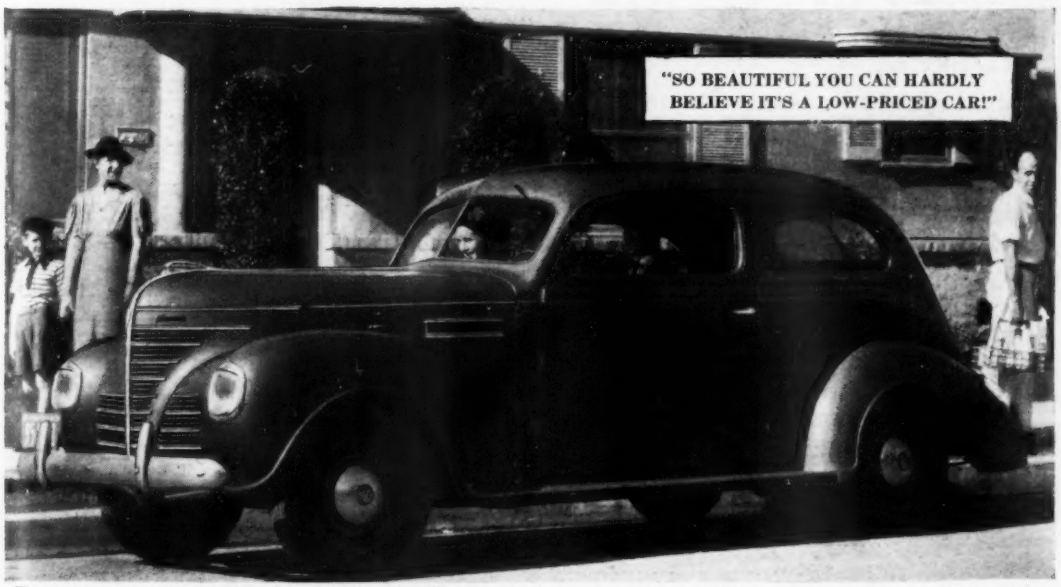
☛ Of the leading low-priced cars, Plymouth is *biggest*—5 inches longer than one; 6 inches longer than the other!

☛ *Every* Plymouth model has the same big, 82-h.p. "L-head" engine—giving full power, *plus* exceptional economy.

☛ The only low-priced car with coil springs—standard equipment *on all models.*

☛ The only low-priced car with a completely rust-proofed Safety-Steel body.

☛ And Plymouth is the only low-priced car with steering-post gear shift standard in De Luxe models at *no extra cost.*



THE NEW PLYMOUTH has famed Floating Power engine mountings and time-proven Hydraulic Brakes.

COUPES START AT $645
SEDANS START AT $685

—DELIVERED IN DETROIT, including front and rear bumpers, bumper guards, spare wheel, tire and tube, foot control for headlight beam with indicator on instrument panel, ash-tray in front and rear, sun visor, safety glass and big trunk space (19.3 cubic feet). Plymouth prices include all federal taxes. Transportation and state, local taxes, if any, not included. PLYMOUTH DIVISION OF CHRYSLER CORPORATION, Detroit, Michigan.

MAJOR BOWES' AMATEUR HOUR, C. B. S. NETWORK, THURSDAYS, 9 TO 10 P. M., E. S. T.

PLYMOUTH BUILDS GREAT CARS

THE "ROADKING"
THE "DE LUXE"

THIS YEAR PLYMOUTH'S THE CAR

Founded 1872

POPULAR SCIENCE
MONTHLY
Mechanics & Handicraft

Volume 134, No. 5

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ALDEN P. ARMAGNAC, Associate Editor
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How Engineers Developed An Amazing Invisible Spark

—That is Giving Instant New Pickup and Power to Thousands of Spark-Weary Motors

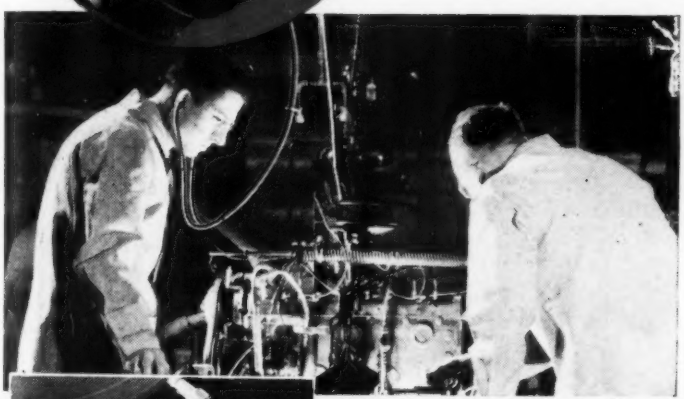
"PRODUCE a spark plug that will deliver better performance from the ignition system—that will work in harmony with all the other ignition units so that they can function as they should!"

That is the challenge that sent Auto-Lite's famous staff of engineers hot on the trail of this "mystery" spark. Electrical specialists for 27 years, they set out to complete the final link in the ignition system by finding a more efficient spark to leap the tiny gap of a spark plug.

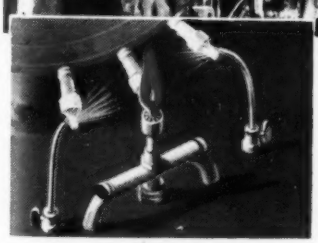
Here is their answer! An invisible spark (the flash you see is only its "tail") utilizing a new principle of "geometric" gap design and a new electrode alloy called Konium. The result? New life for sluggish motors! Sure, quick starting—instant pickup, smooth, flexible power at all speeds.

No wonder nearly a million motorists changed to these new Auto-Lite Spark Plugs last year! That new thousands are changing to them every day. Get a set for *your* car today. Auto-Lites cost no more.

THE ELECTRIC AUTO-LITE CO.
Merchandising Division
Toledo, Ohio



Listening to an Engine's Heart-Beat. Using a sensitive stethoscope, Auto-Lite engineers listen in to test the performance of Auto-Lite Spark Plugs under all conditions.



Frozen and Roasted by Turns. Whether it's starting a cold motor in a refrigerated room or functioning at red heat, Auto-Lite Spark Plugs prove they can "take it."

One Out of Every Four new cars is now factory-equipped with Auto-Lite Spark Plugs.

INSTANT PICK-UP WITH AUTO-LITE SPARK PLUGS

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IT'S a fascinating sight — the inside of a telephone central office where your telephone may be connected with the whole Bell System.

Would you like to know more about the telephone and what happens when you make a call?

Your Bell Telephone Company will be glad to show you. Visitors are welcome and we believe you will have a most interesting time. Why not call the Business Office and arrange a visit?

BELL TELEPHONE SYSTEM

You are cordially invited to visit the Bell System exhibit at Golden Gate International Exposition, San Francisco

ON AN

Indian

MOTORCYCLE

F.O.B. FACTORY $215. FULLY EQUIPPED

THE JUNIOR SCOUT IS THE LOWEST PRICED "TWIN" IN AMERICA

It's a real Indian—the motorcycle you've always wanted, now at a price you can afford to pay! The Junior Scout is a twin-cylinder engineering marvel, packed with power for the man with sporting blood, comfortable to ride, easy to handle. Enjoy thrills and fun with 70-miles-to-the-gallon economy! The Junior Scout and other new 1939 models are at your Indian dealer's now. See him today! Ask about his easy payment plan!

INDIAN is America's fastest stock motorcycle!

FREE! HANDSOME Indian Sport Jersey FREE when you order your new Indian motorcycle. A year's subscription to thrilling "Indian News" for the price of mailing. Send coupon today!

INDIAN MOTOCYCLE CO., Springfield, Mass.

Please send me items checked [ ] Indian News for one year (I enclose 15c in stamps to cover mailing cost). [ ] Certificate of Value entitling me to Indian Sport Jersey FREE when I order my new Indian motorcycle. [ ] Indian catalog.

Name .....

Address .....

PSM 59

Please be sure to check your age group
[ ] 16-19 yrs. [ ] 20-30 yrs. [ ] 31 yrs. and up [ ] under 16 yrs.

INDIAN MOTOCYCLE CO., *Springfield, Mass.*

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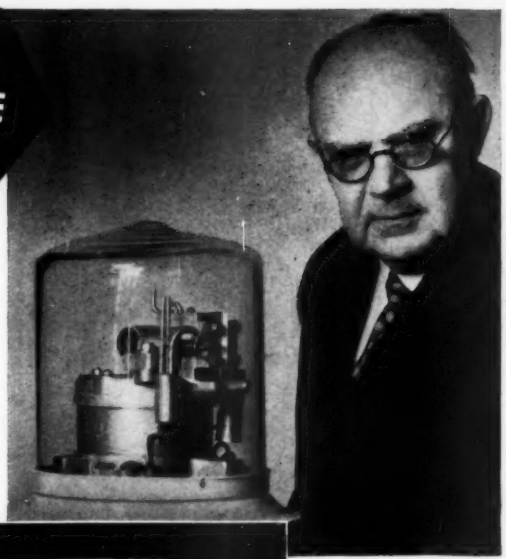
Get the INSIDE STORY of the G-E Triple-Thrift Refrigerator

HERE'S THE MAN AND THE MECHANISM THAT MADE REFRIGERATION HISTORY!



YEARS AGO, General Electric scientists, paced by Chris Steenstrup, famous G-E refrigerator engineer, and prompted by extensive research, completely enclosed and hermetically sealed in steel the G-E refrigerator mechanism. The industry honestly questioned such a revolutionary move. Skeptics said it couldn't be done. But General Electric dared to be different—and the result made refrigeration history.

The G-E Sealed-in-Steel Thrift Unit, constantly improved through 13 years of manufacture, has become famous for its quiet, dependable operation, current savings and long life. It is the most widely imitated cold-making mechanism in the world today! Get the entire "inside story" from your G-E dealer.

CHRIS STEENSTRUP—Chief of General Electric's famed refrigeration engineering laboratories and "daddy" of the widely imitated sealed G-E THRIFT UNIT.

●

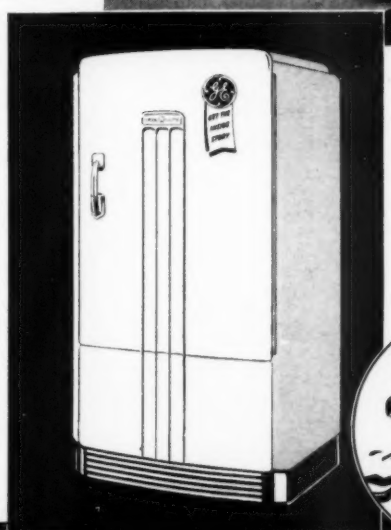
NOW—FOR 1939—G-E GIVES YOU

SELECTIVE AIR CONDITIONS

Sub-Freezing Storage. Low Temperature with High Humidity Storage. High Humidity, Moderate Temperature Storage. Safety-Zone General Storage.

The new General Electric *Triple-Thrift* Refrigerator keeps foods at their fullest, finest flavor with the most practical, low-cost method of food preservation known to modern science. No other refrigerator will keep foods looking better and tasting better *longer* than the 1939 General Electric with Selective Air Conditions.

See G-E "House of Magic" at both World Fairs.



GENERAL ELECTRIC

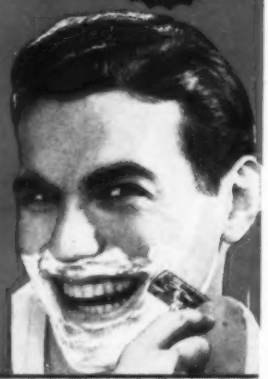
TRIPLE-THRIFT REFRIGERATORS

Quick! Easy! Spick-and-Span
Shaves with This New
Gillette Blade
at ½ Price!

New Kind of Edges on the Easy-Flexing New Thin Gillette Blade Give You Good-Looking, Refreshing Shaves Every Time.

GENUINE shaving comfort at rock-bottom cost! That's what the new Thin Gillette Blade gives you. Making full use of its world-renowned facilities Gillette has produced a top-quality razor blade that sells at 10c for 4. The Thin Gillette gives quicker, easier, better-looking shaves . . . protects your face from smart and irritation caused by misfit blades. Buy a package from your dealer and save money on shaves!

4 for 10c
8 for 19c



You Men Who Want Utmost Shaving Luxury of Course Demand . . .

The Gillette Blue Blade

THERE'S one best in everything. Among razor blades, based on world preference, it's the Gillette Blue Blade. This heavy-duty blade gives immaculate, comfortable shaves that make your face look and feel its best. Every man can afford this luxury—for it costs *less than one cent a day.* Your dealer knows you take pride in your purchase when you ask for these superior blades. Get a package today.

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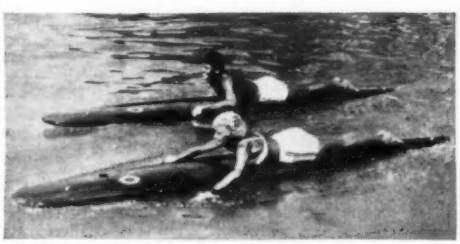


FUN ON A SURFBOARD

WHETHER you live near ocean, lake, or river, you will find that a surfboard adds greatly to your enjoyment of the water. In the June issue of POPULAR SCIENCE MONTHLY, Tom Blake, inventor of the modern hollow surfboard, tells how to construct the latest, improved model. Designed for all-around use, the board carries two persons easily.

ADVERTISING PAGES REMOVED

YES- I'M CONVINCED THAT I CAN MAKE GOOD MONEY IN RADIO. I'M GOING TO START TRAINING FOR RADIO RIGHT NOW.
NO- NOT ME. I'M NOT GOING TO WASTE MY TIME. SUCCESS IS JUST A MATTER OF LUCK AND I WASN'T BORN LUCKY.

BILL SAID "YES" HE'S MAKING GOOD MONEY IN RADIO NOW
THIS N.R.I. TRAINING IS GREAT. AND THEY SENT REAL RADIO PARTS TO HELP ME LEARN QUICKLY
YOU CERTAINLY KNOW RADIO. MINE NEVER SOUNDED BETTER.
I'VE BEEN STUDYING RADIO ONLY A FEW MONTHS AND I'M ALREADY MAKING GOOD MONEY IN MY SPARE TIME
THANKS
OH BILL! I'M SO PROUD OF YOU. YOU'VE GONE AHEAD SO FAST IN RADIO
YES! I'VE GOT A GOOD JOB NOW AND A REAL FUTURE. THANKS TO N.R.I. TRAINING
TOM SAID "NO" HE'S STILL WAITING FOR "LUCK"
BILL'S A SAP TO WASTE HIS TIME STUDYING RADIO AT HOME
SAME OLD GRIND -- SAME SKINNY PAY ENVELOPE -- I'M JUST WHERE I WAS FIVE YEARS AGO
GUESS I'M A FAILURE. LOOKS LIKE I'LL NEVER GET ANYWHERE
YOU'LL ALWAYS BE A FAILURE, TOM, UNLESS YOU DO SOMETHING ABOUT IT. WISHING AND WAITING WON'T GET YOU ANYWHERE

I WILL TRAIN YOU AT HOME *in Spare Time*

FOR A GOOD RADIO JOB

J. E. SMITH, President
National Radio Institute
Established 25 years

Many Radio Experts Make $30, $50, $75 a Week

Radio broadcasting stations employ engineers, operators, station managers and pay well for trained men. Fixing Radio sets in spare time pays many $200 to $500 a year—full time jobs with Radio jobbers, manufacturers and dealers as much as $30, $50, $75 a week. Many Radio Experts own full or part time Radio sales and repair businesses. Radio manufacturers and jobbers employ testers, inspectors, foremen, engineers, servicemen, in good-pay jobs with opportunities for advancement. Automobile, police, aviation, commercial Radio, loudspeaker systems are newer fields offering good opportunities now and for the future. Television promises to open many good jobs soon. Men I trained have good jobs in these branches of Radio. Read how they got their jobs. Mail coupon.

Many Make $5, $10, $15 a Week Extra in Spare Time While Learning

The day you enroll I start sending Extra Money Job Sheets; show you how to do Radio repair jobs. Throughout your training I send plans and directions that made good spare time money—$200 to $500—for hundreds, while learning. I send you special Radio equipment to conduct experiments and build circuits. This 50-50 method of training makes learning at home interesting, fascinating, practical. I ALSO GIVE YOU A MODERN, PROFESSIONAL ALL-WAVE, ALL-PURPOSE RADIO SET SERVICING INSTRUMENT to help you make good money fixing Radios while learning and equip you for full time jobs after graduation.

Find Out What Radio Offers You

Act Today. Mail the coupon now for "Rich Rewards in Radio." It's free to any fellow over 16 years old. It points out Radio's spare time and full time opportunities and those coming in Television; tells about my training in Radio and Television; shows you letters from men I trained, telling what they are doing and earning. Find out what Radio offers YOU! MAIL COUPON in an envelope, or paste on postcard—NOW!

J. E. SMITH, President
National Radio Institute, Dept. 9EP3
Washington, D. C.

J. E. SMITH, President. Dept. 9EP3,
National Radio Institute, Washington, D. C.

Without obligating me, send "Rich Rewards in Radio," which points out spare time and full time opportunities in Radio and explains your method of training men at home to be Radio Experts. (Please Write Plainly.)

NAME ..... AGE .....

ADDRESS .....

CITY ..... STATE .....

Our Readers Say

Would Turn on the Fog To Turn off Enemy Bombers

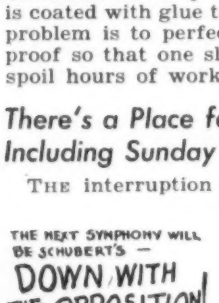
SINCE in the world of science nothing seems impossible, why don't the scientists put their heads together on the subject of air defense. Various plans have been devised for eliminating fog over airports. How about designing some sort of gadget for producing fog. A good soupy fog bank over a large city would be just about the best protection against enemy planes. It's hard enough, I am told, to hit an objective in clear weather. With the target hidden, accurate bombing should be next to impossible. A smoke screen would do the trick, too. Every large chimney could be pressed into service during air raids.—A.L., Baltimore, Md.

He Wants Some Plain Dope on Waterproof Plane Dope

HERE'S a problem for the amateur chemists. Flying-model airplanes are coated with dope to tighten the tissue and make it tough. The underside of the pontoons on model seaplanes is coated with glue to make it waterproof. The problem is to perfect a dope which is waterproof so that one slightly tipsy landing won't spoil hours of work.—R.L.B., Jr., Urbana, Ill.

There's a Place for Everything, Including Sunday Political Talkers

THE interruption of a symphony-orchestra broadcast a few Sundays ago by a political talk, when a radio engineer accidentally pulled the wrong switch, served at least one good purpose. It gave a nation-wide audience a chance to realize how seldom such blunders do occur, and what a mess radio programs would be if countless skilled, capable engineers were not constantly on the alert against errors. And say, while I'm at it, why not leave the radio to music, drama, education, and cultural things, and keep the politicians off the air entirely? —H.A.I., Stamford, Conn.

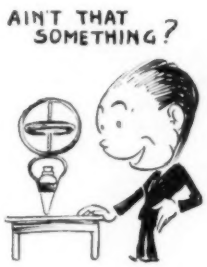


It Costs More To Make Whoopee Than It Does To Make Bookcases

THANKS for the many ideas your magazine has given me. My shop is a twenty by twenty-four-foot building. It's heated by an oil-drum stove, the idea for which you gave me last summer. It is lighted by three Model-T headlights hooked up to a six-volt storage battery that I keep charged with a wind-driven generator which I made. Although I've bought quite a lot of expensive tools in the last year or so, I don't figure that they really cost me so much. Many spend as much in shorter time "making whoopee," as we call it here. I spend my spare time making useful things which give me a lot of pleasure. I am now making the bookcase illustrated in your March issue. Here's wishing you continued success in all your undertakings in the future.—R.F.J., Dollar Bay, Mich.

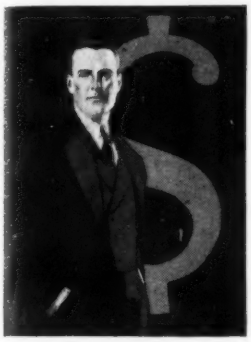
Reader Can't Understand Those "Unstandable" Bottles

WHY can't the iodine-bottle manufacturers take a hint from the ink-bottle manufacturers? It seems that all colored, destructive, and expensive liquids on the market (with the exception of ink) are sold in "unstandable" bottles. If these bottle manufacturers insist on such bottles—all tops and no bottoms to speak of—may I suggest that they install gyroscopes operated by perpetual motion to keep these bottles from tipping over when exposed to a mild breeze or when some one says boo? I say three cheers for the ink-bottle manufacturers, and boo to the iodine-bottle manufacturers.—T.T.P., Wayne, Mich.



Parabolic Curves, the Rule for Suspension-Bridge Cables

IN RESPONSE to I.A.'s question in the March issue, let me say that the main cables of a suspension bridge neither hang in a natural, catenary curve nor take the shape of a segment of a circle, but that the connecting rods are made of such lengths that the cables assume parabolic curves. It is shown in most books on mechanics *(Continued on page 14)*



Plan Your Future

Choose Your Field NOW For Success

Will you master fate or will fate master you? That's a question deserving your honest answer . . . right now! Actually it is largely up to you. You can do with Life almost what you will. LaSalle will help you establish yourself for real success by providing you with the comprehensive, specialized training for which it is so famous. Choose your field . . . now! Check the coupon below for the free booklet you want us to send you. It can be your first step toward assured success.

Opportunities in Traffic Management

The field of Traffic Management offers real opportunity only to the man who knows. Spare time study and the will to succeed have pushed scores of Traffic employees up the ladder to financial success. Many LaSalle-trained traffic managers—both in the railroad and industrial field—now command salaries of $3,000.00 to $5,000.00 a year—and better. Investigate. Find out how you can qualify for these higher positions through LaSalle home-study and guidance.

Law *for Business Success*

And it isn't necessary to practice law to get this Success. In fact probably most of the men who study law today have no idea of taking the bar examination or becoming lawyers—they want law training to give them mastery of men and situations in business. You know that—

(1) the man with legal training is a leader—not a follower.

(2) legal training keens your mind—clears away the problems that stump the ordinary fellow and makes you master instead of man.

(3) knowledge of law simplifies the complications of executive work.

(4) Many top executive places are filled by men who have studied law.

No matter whether you are in a big corporation or a small business—in a great city or a little town—a practical knowledge of law cannot fail to be of real and vital help to you in making a more successful career.

In every state in the union you'll find law-trained men who came up through LaSalle. What others have done, you can do.

And LaSalle offers either a full law course leading to LL. B. or a shorter business law training—whichever you prefer. All text material, including valuable 14-volume Law Library. Training comprises the most effective features of modern law instruction.

Executive Training

Executives who are efficient managers command responsible positions and good incomes. And the need for trained executives is growing rapidly. We train you thoroughly at home in your spare time for every type of executive work—teach you the principles and practices used by our most successful business leaders and help you develop your management capacity—by a training built with the aid of outstanding executives.

Become an Expert Accountant *The Profession That Pays*

The demand for skilled accountants—men who really know their business—is increasing rapidly. New state and federal legislation requires much more, and more efficient accounting from business—big and small. Corporations are in constant need of expert counsel in matters relating to Auditing, Cost Accounting, Business Law, Organization, Management, Finance. Men who prove their qualifications in this important branch of business are rapidly promoted to responsible executive positions—given an opportunity to earn real salaries. The range is from $2,000.00 to $10,000.00 a year—even to higher income figures.

Under the LaSalle Problem Method you can at home acquire a thoro understanding of Higher Accountancy, master its fundamental principles, become expert in the practical application of these principles—this without losing an hour of work or a dollar of pay.

Your training will be under the direct supervision of a staff of legal, organization and management specialists, business efficiency engineers and Certified Public Accountants.

Preliminary knowledge of bookkeeping is unnecessary. We train you from the ground up, or from where you now are, according to your individual needs.

Mr. Salesman: *What's Wrong?*

Why aren't you making more sales—more money? Is it you—or your proposition? Check up first on yourself. Other men—no better than you—have found their earnings jump and stay up when they trained with LaSalle. Literally thousands of men—many of them years at the game—have increased their sales volume and earnings through home study with LaSalle guidance. Sound—practical—usable—right from field experience. Train for top-notch production with LaSalle.

LASALLE EXTENSION UNIVERSITY A CORRESPONDENCE INSTITUTION Dept. 583-R, CHICAGO

I would like to have your special booklet—without any cost or obligation to me—about my opportunities and your success training in the business field I have checked.

- ☐ Higher Accountancy
- ☐ Law: Degree of LL.B.
- ☐ Traffic Management
- ☐ Modern Salesmanship
- ☐ Business Management
- ☐ Commercial Law
- ☐ Expert Bookkeeping
- ☐ C. P. A. Coaching
- ☐ Industrial Management
- ☐ Modern Foremanship
- ☐ Business English
- ☐ Business Correspondence
- ☐ Effective Speaking
- ☐ Stenotypy

Name_____ Age_____

Position_____ Address_____

Our Readers Say (CONTINUED)

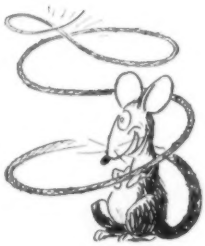
that this shape prevents overloading of individual connecting rods, provided that these rods are equally spaced, and that the roadbed is of uniform weight.—J.M.W., Hartford, Conn.

It's Got Him Perched on the Edge of His Chair

IT'S A long time since I've read a more thrilling story than Edwin Teale's "Captain Kidd's Gold?" that started in your April issue. I can hardly wait for the next installment. The almost incredible ingenuity used in burying whatever it is—and it *must* be something worth going to all that trouble to hide—is an amazing thing in itself. Added to that are the dramatic elements of suspense and the unknown, with a romantic background of possible piracy, intrigue, and skullduggery that may yet put the fiction writers to shame by bringing us into contact with actual events that our better judgment tells us should never have taken place—should, by rights, be wholly preposterous. Gosh, anything can happen in this old world, can't it?—S.P.W., Alameda, Calif.

There Seems To Be No End to Those Amazing Rat Tales

IF YOUR readers can stand another rat tale, here's one for the books. I not only couldn't catch a rat that was making itself at home in my cellar, but I couldn't find where it was getting in and out. The cellar is sealed at every point but one: a waste-pipe vent in the floor. To stop this up, I jammed the wire guard from an old trouble lamp, of the kind used in garages, into the hole. There was a burned-out lamp bulb in the guard. One evening, my terrier nearly went frantic over something. After scouting around the house, I opened the cellar door. The dog flew downstairs. There followed a bedlam of squeals and growls, and then an ominous explosion. You guessed it: The rat had pushed its way into the lamp guard and got stuck. My dog heard the disturbance and dispatched the rat and, in the process, the lamp bulb as well. The dog suffered no injury from the broken glass of the bulb, and Brother Rat bothers us no more. Can anyone beat this tale?—G.O'W., Glen Ridge, N.J.



How To Reduce Competition for the Family Car

IN THE March issue of P.S.M., on page 97, I see that special license plates for traffic violators are being considered in Memphis, Tenn. The idea is all right for cars that are driven only by the violators, but I'll wager that most cars are driven by more than one person. I'm sure I wouldn't enjoy being seen at the wheel of a car with such license plates. Five out of six members of my family drive our car. Does this mean that if one of us is a violator, all of us will be punished by being forced to drive a car bearing such license plates?—C.B.A., Esterly, Pa.

If He Bowed to a Mermaid He'd Be a "Dead Pigeon"

ON PAGE 132 of your March issue, the amateur diver is doing one of the most dangerous things he could, namely, diving with his helmet tied on. If he should lose his footing, or even bend over, he might easily be a dead pigeon before he knew what was happening. Water would flood the helmet. Under water, things can happen with terrible swiftness. If a diver's air is cut off, his chances are mighty small unless he can get this type of helmet off and get back to the surface of the water again in a hurry.—C.A.H., Pittsburgh, Pa.

This Should Put a Stop to That Automobile-Brake Idea

IN reply to T.D.S., in the April "Readers Say," it would be practically impossible to rig up an efficient automobile braking system that would conserve enough wasted braking energy to make it worth a two-block drive to look at. To begin with, remember that the huge mountain locomotives retard their downhill speeds by putting power from their momentum back into a generator which is the same piece of machinery as the driving motor. In other words, no additional *(Continued on page 16)*

You Ask Me What I Am Doing?

I Am Getting Ready to Earn More Money . . . Preparing for a Bigger Job

I am a student of the American School, Chicago. A little more than half way through my course—already my increased knowledge has brought me promotion as a result of the hour or so a day I have been spending getting acquainted with the principles of the work I enjoy. I use only part of my spare time, so it doesn't interfere with my home and social life, and certainly helps me on the job.

I have been surprised at the practical manner in which even advanced work is explained. It is a lot easier than I had expected. I only wish I had started this plan of getting ahead a few years earlier. But when I was 18 to 20 I felt pretty sure of myself. I didn't take enough stock in what more experienced people told me about the importance of being thoroughly trained for the job I wanted.

You Can't Win If You Don't Try

American School, Dept. G546, Drexel Ave. at 58th St., Chicago

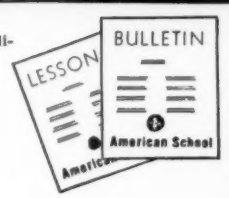
CUT ALONG THIS LINE

Try a Lesson Yourself—No Obligation

American School, Dept. G546, Drexel Ave. at 58th St., Chicago

I have checked the line of work in which I would like a good job. Please send me without expense or obligation on my part a copy of your Bulletin and an early lesson in the field I have selected.

- ☐ Air Conditioning
- ☐ Architecture
- ☐ Automotive Engineering
- ☐ Automobile Repairing
- ☐ Bookkeeping and Cost Accounting
- ☐ Business Management
- ☐ Civil Engineering
- ☐ Aviation
- ☐ Contracting, Building
- ☐ Electrical Engineering
- ☐ Diesel Engineering
- ☐ Drafting and Designing
- ☐ Electric Refrigeration
- ☐ Heating, Ventilating, Plumbing
- ☐ Professional Accounting Incl. C. P. A. Coaching
- ☐ High School
- ☐ Highway Engineering
- ☐ Law
- ☐ Liberal Arts (College)
- ☐ Mechanical Engineering
- ☐ Merchandising
- ☐ Private Secretary
- ☐ Radio and Television
- ☐ Salesmanship
- ☐ Shop Practice
- ☐ Steam Engineering



Name---------- Age---------- Occupation----------

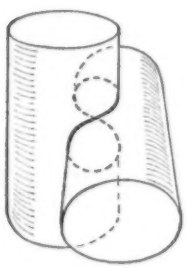
Street---------- City---------- State----------

Our Readers Say (CONTINUED)

equipment is needed. In a car, the gasoline engine can't be turned into an electric generator—at best it could be converted into an inefficient air compressor. If T.D.S. wants to experiment, it would be my suggestion that he begin with a gasoline-electric driving system. But let him remember that he mustn't add weight to his car, because most of the energy he stores up will then be used up to lift that weight over the next hilltop!—G.S.A., Detroit, Mich.

Here's an Oddity with a Curious Twist

HERE is a little oddity that came to light at my drafting board. Suppose you view two cylinders, which meet at ninety degrees and intersect each other to the halfway point, from the angle shown in the drawing. A perfect figure "8" will be formed when you draw the line of intersection of their surfaces. The actual shape of this line in three-dimensional space is even more cockeyed and interesting. Make it out of wire, as I did, and you can roll it or stand it on your desk top in all kinds of seemingly incompatible positions. It takes on a weird variety of shapes as you look at it from different angles.—P. d'A., Cambridge, Mass.



In Pursuit of Knowledge About Pursuit Planes

THAT new pursuit plane with two motors instead of one, that recently was called a great success, even though it did crack up in some trees, was a revelation. For a long time, we've been accustomed to thinking of single-motored planes as the fastest, and multiple-motored planes as the sturdy, weight-carrying type. This is all wrong, it seems. We now hear that the ultimate speed in single-motored planes has been reached, and additional speed can come only by adding power plants, since no more power can be extracted from a single airplane engine. Who's been getting kidded, if anybody? Perhaps an article in good old P.S.M. would clear up some of the mystery. —M.A.H., Erie, Pa.

A Money-Raising Problem That Won't Cost You a Cent

HERE is a problem for your readers to work out. A civic club has a certain number of members. Its charter members pay dues amounting to $4.50 a year, the rest pay a larger amount. The total amount of dues collected annually comes to $1,880. The organization wants to raise $1,000 to buy a statue of Civic Virtue to present to the municipality. Each of the members paying dues of $4.50 a year is assessed $3. Each of the other members is assessed one half of his annual dues. This raises the exact amount of money needed to pay for the statue. How many members pay dues of $4.50 each year?—G.C., New Orleans, La.

One Meets Such Interesting Creatures Cavorting Through P. S. M.

HAVE just finished reading your article on raising goats as a hobby. What about white mice? The raising and breeding of white mice is also a fast-growing hobby in the United States. I am sure many readers, including myself, would enjoy an article pertaining to these interesting creatures. I have been reading your magazine for about three years and prefer it to other magazines of this nature. Hoping you will accept my suggestion. —H.J.H., Philadelphia, Pa.

The Cards Were Stacked Against This Game of Poker

THE next time I invite the boys in for a little quiet game, you can rest assured that my copies of POPULAR SCIENCE will be safely tucked in some out-of-the-way corner. It all happened about two weeks ago. My wife was away, and, being left to my own devices, I decided to get a little gambling out of my system. While a few of us were waiting for several late-comers to arrive, one of the boys happened to spy an old copy of the magazine in my bookcase. Paging through, he came to your article "What Are Your Chances?" —you know the one that gave the low-down on gambling odds. Well, that was the beginning. The rest of the night was spent flipping coins, dealing cards, and figuring horse-racing odds *in the interests of science*. We didn't even get around to matching pennies, and that game of poker I'd planned is still smoldering in my system.—R. F. P., Chicago, Ill.

ADVERTISING PAGES REMOVED

Do You want to get ahead?..then...

Read these 8 letters!

Two Raises, One Promotion After But 7 Months

Today, after 7 months of study, I have received one promotion and two raises in salary—sufficient to pay the entire cost of the training in a short while. It can easily be seen that I haven't even begun to reap the benefits I expect to get in the *next* 7 months!
T. G. Jr., Tex.

Clerk to Ass't Mgr. in Only 8 Weeks

In less than 8 weeks from my enrollment for your Higher Accountancy Training I was promoted from clerk to assistant manager of the largest A. & P. super-market in central New York.
T. F. F., N. Y.

Two Promotions in First Year

At the time of my enrollment about a year ago, I was in our Yakima office in charge of collections. 3 months from that time I was moved to a district office as office manager. 6 months later came my transfer to Lewiston as district manager. My LaSalle training has certainly paid big dividends. And I haven't even completed it yet!
D. E. W., Idaho

C.P.A. Firm Recommends Simplicity of Training

Many, many times men have asked members of our firm for advice regarding an effective, well-taught accounting course. I have recommended LaSalle invariably. The Problem Method used is an ideal, practical presentation and is so simplified that the average man can readily master the work.
H. A. S., S. D.

Clerk Aided by LaSalle Is Now Auditor

Several years ago, I graduated from LaSalle in Accountancy. At the time I enrolled, I was a clerk. At the present time, I hold the position of auditor. I have always found LaSalle training *good* training.
W. A. S., Ky.

Easily Pays Tuition by Outside Work

My progress the first 6 months was sufficient to enable me to handle several outside audits which more than paid my complete tuition. Other tangible results have been a raise in salary at my original position, and, later, a change to my present work as assistant budget director for the State of ———.
V. C. G., ———.

University Executive Finds Training Comprehensive and Well-Presented

My work is that of cashier and manager of ——— University's Accounting Department. I am in direct connection with education and, with my background, feel able to judge accurately the worth of any extension course. I have not yet found another as comprehensive and well-presented as that offered by LaSalle, and believe anyone who will put the effort into it is bound to succeed.
R. M. B., S. D.

Skeptic Becomes Booster When Given Raise —Promised Promotion

When I enrolled in your Higher Accountancy 8 months ago, I was skeptical regarding any immediate benefit. Now all doubt has been dispelled. Within 4 months, I received a 25 per cent increase in salary, equal to 300 per cent of my monthly payments to LaSalle. And this is only the beginning, since I have been promised further increases in salary and promotion.
O. L. F., Ill.

They are evidence that success and promotion come fast to trained men!

Stop *hoping* for that raise or promotion! Begin *earning* it—in the way that *cannot be overlooked by your employers!*

Isn't it pretty obvious that maybe so far you aren't going about things in the right way? And isn't it equally obvious that the men of those letters quoted above found a more effective way—through LaSalle accountancy training?

Take a tip from these experienced men. Reason it out for yourself! What has worked out so well for those men—and for thousands and thousands like them—*IS ALSO PRETTY APT TO WORK FOR YOU!* That's just common sense.

Like them, why not investigate? Send the coupon—that's the first move.

Next we will gladly lay before you all the details of this proved success-building program—without obligation. Then make your own decision in the light of all the facts. The coupon will bring you full information in this fascinating *FREE* book of 48 pages. Send for it—*NOW!*

LaSalle Extension University
A CORRESPONDENCE INSTITUTION

Dept. 583-HR **Chicago**

I'd like to have your free booklet, "Accountancy, the Profession That Pays," about the training that these 8 men liked so well.

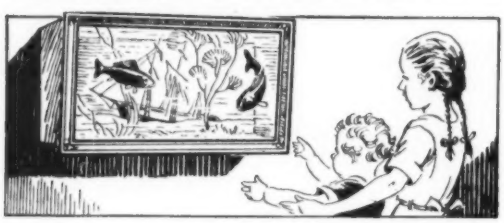
Name .....

Address .....

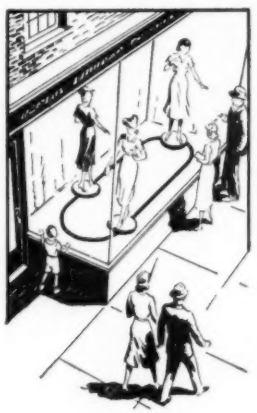
Position ..... *Age* .....

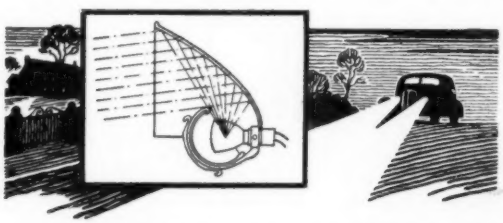
With the Inventors

BANDITS adept at snatching the brief cases and bags in which bank messengers deliver bonds, stocks, and other valuable securities will get the shock of their lives when they try to nab an electrified leather bag invented by William H. Davidson, of Toronto, Canada. Powered by batteries, an electrical shocker built into the bag and capable of generating a high-tension current is wired to the handles and to metal strips laid along the exterior of the carrying case. No current flows to the handles or metal strips while a special key, attached to the messenger's wrist by a strap, remains inserted in a control mechanism located at the top of the leather container. When a bandit grabs the bag, however, the key will pull out, switching on the high-tension current, and strongly impressing on the robber the fact that he has a "hot" piece of loot on his hands. . . . IN THE FIRST TEN YEARS following the passage of the act creating the U. S. patent system in 1790, only 290 patents were granted. Today, between 750 and 1,000 patents are granted *every week*. . . IF, SOMETIME SOON, you see fish lazily swimming across the wall of your living room, don't send a rush call for

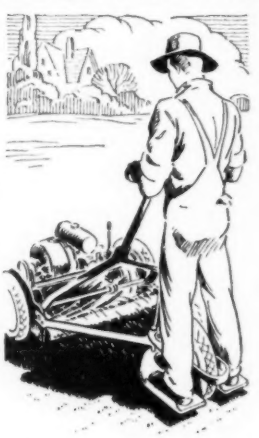


the doctor. Some member of your family has probably purchased a wall aquarium of the type devised by Morris Skolnick, of New York City. Mounted within a decorative frame, a rectangular glass fish bowl has an underwater scene across the back to serve as a background for fish and water plants. The entire unit is suspended on wall hooks. . . ON AN AVERAGE, it takes about thirty-four months to obtain a patent. Some require much less time, but one, relating to automobiles, was not granted until thirty-three years after the initial application. . . FOR THE BENEFIT of sidewalk shoppers, dummy dress models parade around display windows to show their costumes from all angles, in a system worked out by William Dickinson, of Seattle, Wash. Mounted on pedestals attached through a floor slot to a driving mechanism below, the manikins move along the front of the display-window platform, swing around at the end to face the opposite direction, and return across the back of the window area to a turn at the other end that completes their circuit. . . AN AVERAGE OF





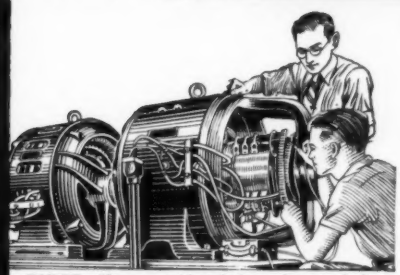
more than 40,000 patents are pending at any one time. . . AS A FORWARD STEP in solving the problem of nighttime glare from automobile headlights, George H. Parks, of Saginaw, Mich., contributes an antiglare headlight of unusual design. In the unit, all of the light rays from the bulb are deflected upward to a curved reflector that throws the beams out onto the road in a slanting, downward direction so that they cannot possibly shine directly into the eyes of oncoming motorists. . . . OUT OF THE THOUSANDS of patents issued in the United States last year, approximately one in every



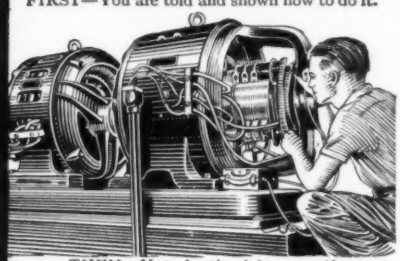
(Continued on page 24)

TRAIN THIS QUICK EASIER WAY FOR ELECTRICITY

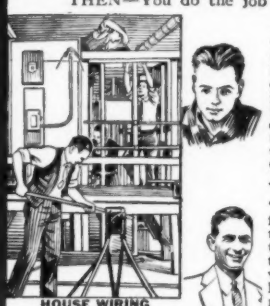
12 Weeks Practical WORK IN MY CHICAGO SHOPS



FIRST—You are told and shown how to do it.



THEN—You do the job yourself.



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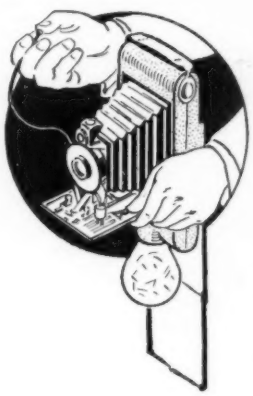
With the Inventors

(Continued from page 22)

five was related in some way or other to automobiles. . . A ONE-WHEEL TRAILER makes life easier for the operator of a hand-guided, power-driven lawn mower. Foot-size platforms mounted at either side of a single trailer wheel drawn by the powered mower allow the operator to stand up and ride, instead of walk, behind the grass cutter as he guides it back and forth across a lawn. This is the joint invention of John J. Meagher, of East Chelmsford, and Bernard F. Meagher, of Lowell, Mass. . . NAMING PATENTS ACCURATELY sometimes results in curious titles. 1,147,147, for instance, reads: "Hot Top For Big-End-Down Ingot Molds." . . . SKIRT HEMS ARE BASTED automatically by a novel machine credited to Thomas A. Benton, of Cincinnati, Ohio. The apparatus forms an even hem, folding the material and pinning it up at spaced intervals. . . PROTECTION AFFORDED BY the patent laws applies not only throughout the continental United States but also in Alaska, Hawaii, the Virgin Islands, Guam, the Panama Canal Zone, and, upon compliance with certain regulations, in Puerto Rico, and the Philippine Islands . . . CAMERA, SYNCHRONIZED flash lamp, and reflector are combined in one unit invented by George F. Boesser, of Arlington, N.J. An auxiliary back on the camera slides down to form a reflector for a flash bulb screwed into a socket in the camera base. When the shutter is released, the flash lamp is automatically set off by built-in batteries . . . ACCORDING TO OFFICIAL regulations, patents are *not* granted for "useless devices, for printed matter, for methods of doing business, for improvements in devices which are the result of mere mechan-



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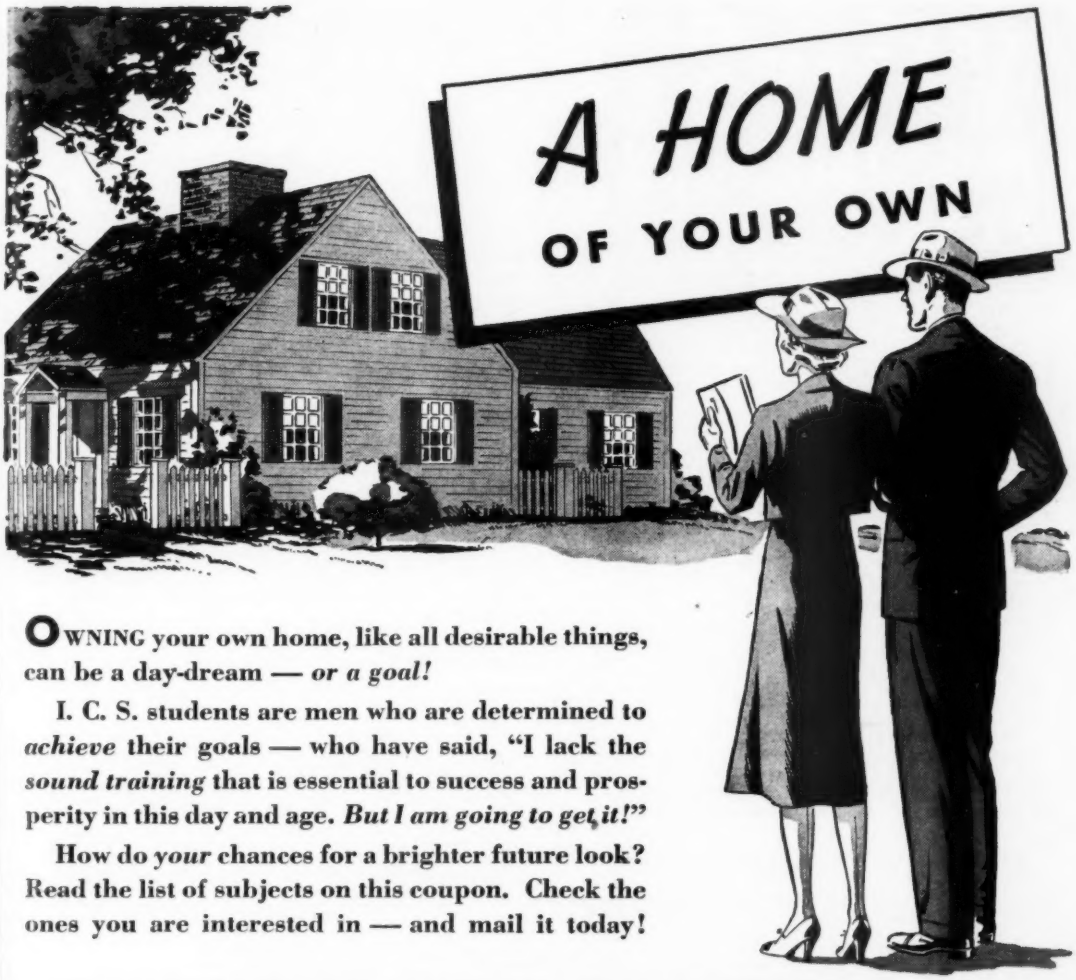

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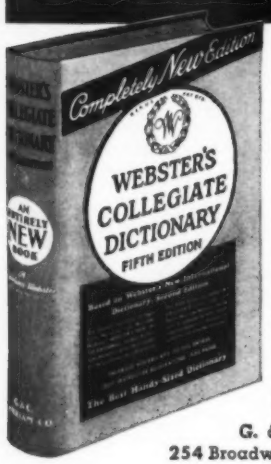

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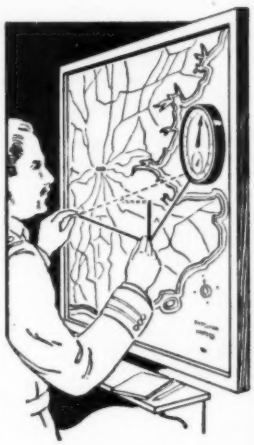
With the Inventors

(Continued from page 24)

ical skill, nor for machines that will not operate, particularly for alleged perpetual-motion machines."



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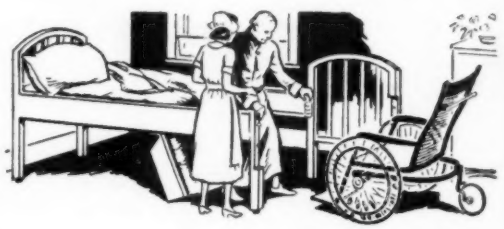

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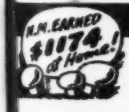

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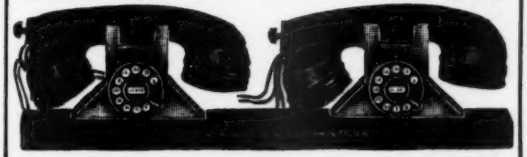

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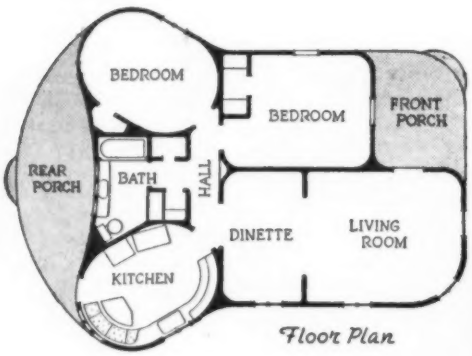
Hints for the Home Owner

NEW LOW-COST HOUSE MADE OF STEEL AND CONCRETE

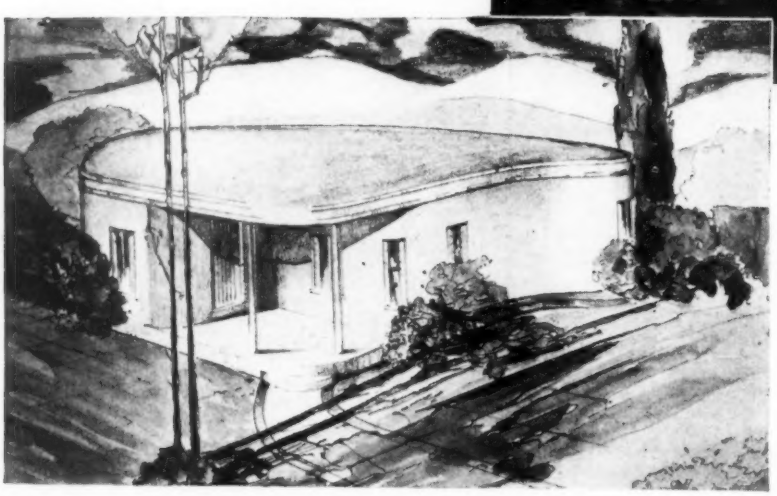
NO BOLTS, screws, boards, or timbers are used in the construction of a new type of welded-steel frame house designed by B. J. Compton, of San Francisco, Calif., and recently built on lots in Fresno, Modesto, and on Treasure Island, the man-made site of the San Francisco World's Fair. Proof against termites, rats, and fire, and insulated against heat, cold, and sound, the welded structure is resistant to floods, earthquakes, and severe weather conditions. Floors and roof of the unusual dwelling are made of cement mixed with powdered and rock pumice aggregate, to lighten the load and forestall cracking. The concrete floors are suspended from exterior dwarf walls, while sidewall framing consists of flexible steel studs welded to flat bars that are nailed directly to the soft cement foundation. Window frames, all made in multiples of sixteen inches, are welded to studs placed sixteen inches apart.

The roof is supported by steel "bowstring" trusses, the lower chords of which act as the ceiling joists. Double walls furnish a four-inch dead-air space for heat and sound insulation of side walls. For greater flexibility, fireproofing, and insulation of interior and exterior walls, pumice is mixed with the plaster and stucco. Although unusual in design as well as construction, the modern house, pictured in the drawing reproduced below, is entirely practical. Oval rooms with rounded corners eliminate right-angle dust traps and allow a free circulation of air, which is admitted through vents under the windows and is conditioned by passing over coils containing either heated or chilled water. Approximately 100 tons of steel were used in the dwelling shown below, even room doors being made entirely of metal. All materials for the houses are of standard size and easily obtainable. It is estimated that the cost of construction averages less than $1,000 a room.



Floor Plan

Welding the all-steel wall framing. Note how the concrete floor is laid on the foundation


One of the modern woodless houses. The floor plan shows the unusual rounding off of corners

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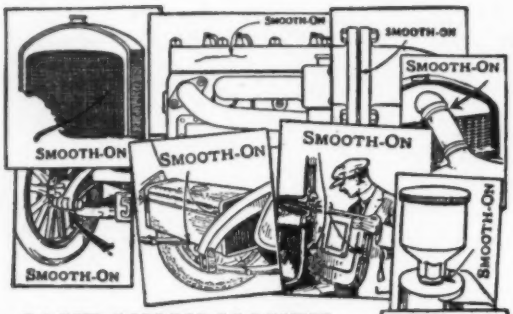

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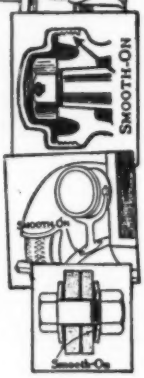


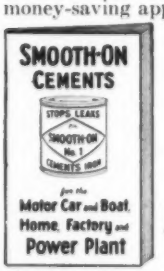
STOP LEAKS

of *water* from a frozen, punctured or corroded radiator (nothing put inside), from a cracked engine jacket or from a loose hose connection; of *lubricant* from a cracked crank, gear or differential case or bad joint; of *gasoline* from tank or line joint; of *exhaust fumes* from manifold, muffler or heater connections.

MAKE LOOSE PARTS TIGHT

Smooth-On No. 1 makes solid connections . . . keeps lubricator terminals, grease cups, hub caps and nuts from backing or dropping off; tightens loose fenders, lamp, tire and license plate carriers; makes screws stay tight in hinges, locks, robe and foot rails, window and dash moulding; tightens loose spring bushings to prevent wear and squeaking. A bolt with Smooth-On No. 1 under head and nut washers makes a strong replacement for a weakened rivet.

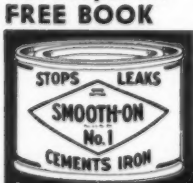
Smooth-On No. 1 metallizes quickly, holds perfectly on any metal and is proof against vibration and heat. In addition to the repairs listed, dozens of practical money-saving applications in the home make Smooth-On a necessity to every handy man.



Anyone can get thoroughly satisfactory results by following the illustrated directions in the free repair booklet.

Send for your copy, and get Smooth-On No. 1 in 7-oz., 1-lb. or 5-lb. can from your hardware store or if necessary from us direct.

Mail coupon for FREE BOOK



SMOOTH-ON MFG. CO., 574 Communipaw Ave., Dept. 58, Jersey City, N. J.
Please send the free Smooth-On Repair Book.

Name .....

Address .....

5-39

Do it with SMOOTH-ON

Paint Brushes Kept Soft in Chemical Conditioner

BRUSHES used for applying paints, varnishes, lacquers, shellacs, and enamels of all kinds are kept in first-class condition in a chemical brush conditioner now on the market. After use, brushes are hung on clips in a container that fits into the larger container pictured in the center, above. An air-tight metal cover is clamped down, and a slowly evaporating liquid at the bottom of the unit generates a heavy but nonpoisonous and noninflammable vapor that drives out all oxygen and thus prevents oxidation and hardening of the paint remaining on the brush bristles. One pint of the chemical is sufficient to make the brush conditioner function satisfactorily for a period of two months. Used brushes with bristles that have hardened, the manufacturer states, can be reclaimed and rendered fit for use again by a week's storage in the brush conditioner.

Questions FROM HOME OWNERS

Q.—WHAT can I use to fill up cracks between the boards on my living-room floor? Some of these measure as much as a quarter inch across.—W.D., Port Chester, N.Y.

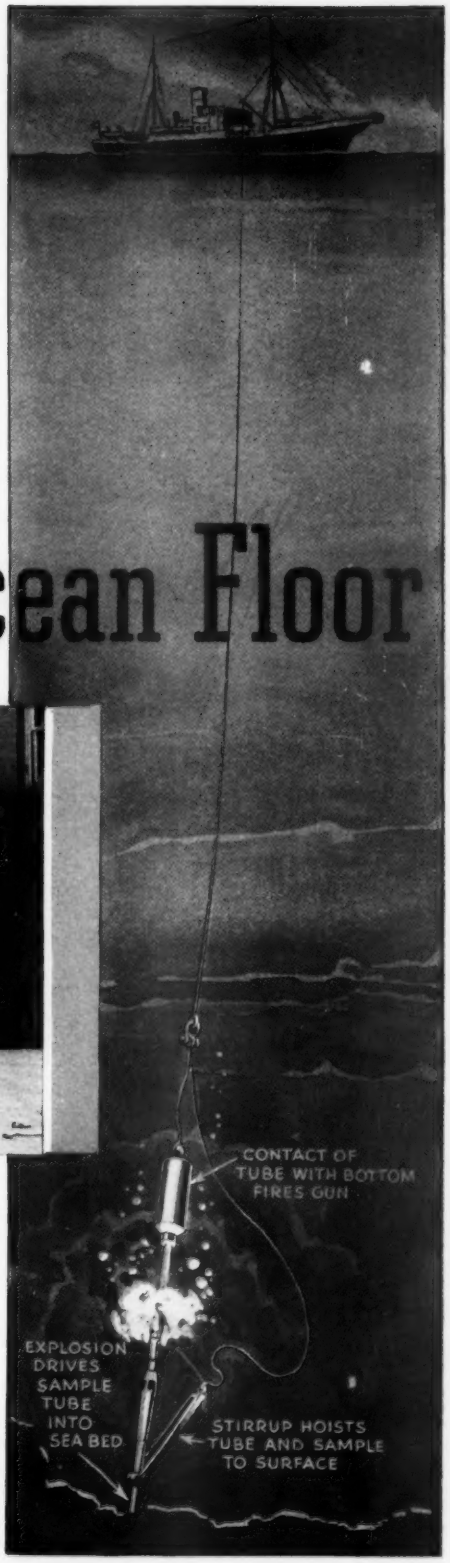
A.—SOAK white blotting paper in water and squeeze out the excess. Knead whiting and glue size into this softened paper until it forms a putty, after which it may be tinted with dry colors to match the floor. Wet the cracks and press the putty firmly into them, smoothing it out as evenly as possible. When dry, sandpaper flush with the surface of the floor. Another excellent filler is ordinary cornstarch mixed with equal parts of linseed oil and turpentine, with sufficient japan drier to set it quickly. Wet cracks with linseed oil.

POPULAR SCIENCE Monthly
RAYMOND J. BROWN
Editor

DEEP-SEA PROSPECTORS SEEK

Radium from the Ocean Floor

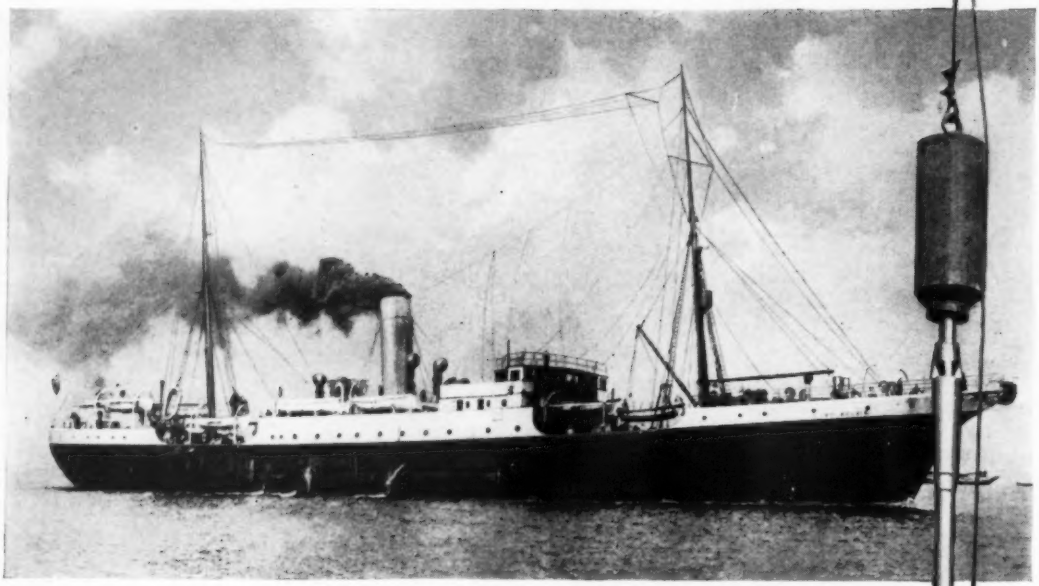
Dr. Charles S. Piggot and the seven-mile cable he will use in deep-sea prospecting


CONTACT OF TUBE WITH BOTTOM FIRES GUN
EXPLOSION DRIVES SAMPLE TUBE INTO SEA BED
STIRRUP HOISTS TUBE AND SAMPLE TO SURFACE

WITH the aid of the longest rope in the world, a steel cable that stretches seven miles from end to end, Dr. Charles S. Piggot of the Carnegie Institution is going treasure-hunting at the bottom of the sea. He seeks the most costly of all precious metals—radium, whose fabulous value exceeds $10,000,000 a pound. And preliminary undersea explorations have convinced him that the red, oozy mud of the ocean's bed far excels the richest of land-mined radium ores!

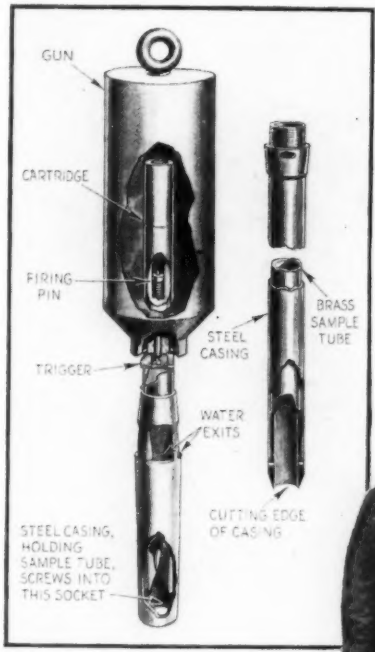
Armed with one of the strangest of prospecting instruments—an ingenious submarine cannon—

By ARTHUR GRAHAME



Western Union cable ship "Lord Kelvin," on which successful preliminary tests were made

Dr. Piggot will set sail for some of the deepest spots of the sea. In mid-ocean, he will lower the gun at the end of his seven-mile cable, until it hits bottom. The impact will detonate a cartridge filled with gunpowder and drive into the sea floor a ten-foot brass tube, several inches in diameter and open at top and bottom. Then the scientist will haul up the tube with the "core sample" of clay or gravel that it incloses. Assaying the contents will test his theory that the muddy layer holds an Eldorado of mineral treasure for the first to succeed in tapping it.



Cut-away view at left shows how the submarine cannon is constructed. At right, the apparatus as it appears when lowered from a ship to take a bite out of the floor of the sea

Mines in Colorado and Utah produced the radium that the world uses for treating cancer, and for the luminous paint on watch and clock dials, until the discovery of richer deposits in the Belgian Congo shut them down. Still better finds of radium ore, in the Great Bear Lake region of northwestern Canada, have broken the Congo monopoly in turn. Will the next step be to mine the sea for radium?

First indications of this startling possibility came to light several years ago when Dr. Piggot, studying the geological history of the ocean floor, analyzed small specimens of sediment dredged up far from land. An expert on radium-bearing rocks, he was amazed to find the sea mud richer in

the radioactive element than any terrestrial ore he had ever examined.

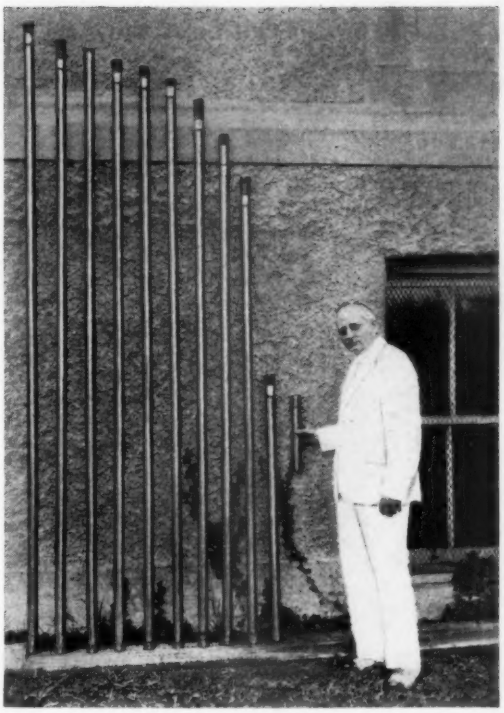
These pioneer samples were obtained with a "telegraph snapper," an ingenious little tool devised by submarine-cable engineers to find out what kind of a bed their cables would lie upon. When it is lowered from a ship at sea, on the end of a line several miles long, contact with the bottom releases its spring-actuated jaws and it bites out a double handful or so of the sediment for examination. Unfortunately, from a geologist's viewpoint, it merely scrapes the surface. Not knowing what lay beneath this superficial radium-bearing layer was as provoking, Dr. Piggot says, as being able to read only the topmost page of a fascinating book.

So, to read the other pages, he invented an entirely new tool—his miniature cannon or "core sampler," as he calls it. How it harnesses gunpowder to do its work is shown in accompanying drawings. The sample that it brings up, represents the complete history of deposits that have slowly accumulated through millions of years.

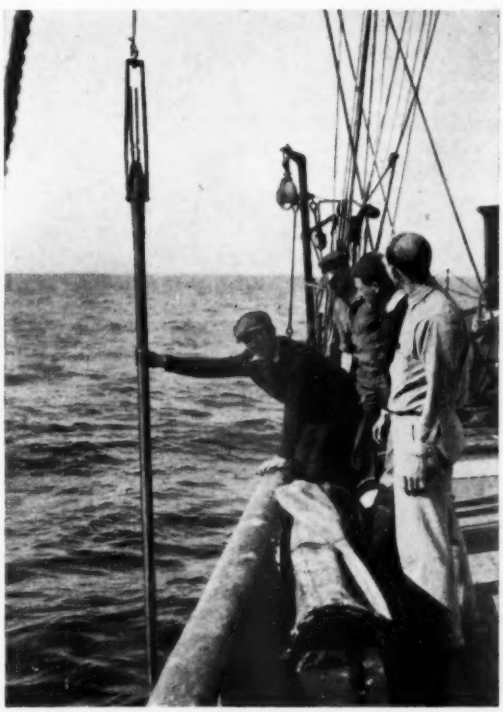
Trials of the submarine gun have already shown how well it works. As an invited passenger on the Western Union cable ship *Lord Kelvin*, bound from Newfoundland to repair a cable break near Ireland, Dr. Piggot lowered his device eleven times to the bottom and brought up samples of the sea floor from depths as great as three miles. Now, in a more extensive mineral survey, he plans to explore ocean abysses even as profound as a recently discovered, record-breaking "deep" of 35,000 feet.

Rope makers told Dr. Piggot that a seven-mile wire cable strong enough to support its own weight was an impossibility—to say nothing of the added task of hauling up the 600-pound gun and its projectile from the depths. Undaunted, he proposed a tapered rope, that would become thicker where the strain on it increased. So they have just filled his order for one that measures five sixteenths of an inch in thickness at its lower end, and increases by one-sixteenth-inch steps to a thickness of five eighths of an inch at its upper end. Where the different thicknesses join, the splices are thirty feet long instead of the usual twelve or fifteen feet. The record-breaking rope weighs five tons, and tests have shown that it has the necessary strength. For use, it is wound on a winch drum operated by a 100-horsepower Diesel engine. The complete apparatus, weighing ten tons, can be transferred to any ship, and is now awaiting service at the Carnegie Institution's geophysical laboratory in Washington, D. C.

If Dr. Piggot's new survey confirms the indications of all samples gathered to date—that untold riches in radium lie beneath the sea—how can the treasure be mined? For



These tubes contain samples obtained in the early tests. Analysis showed that they were rich in radium

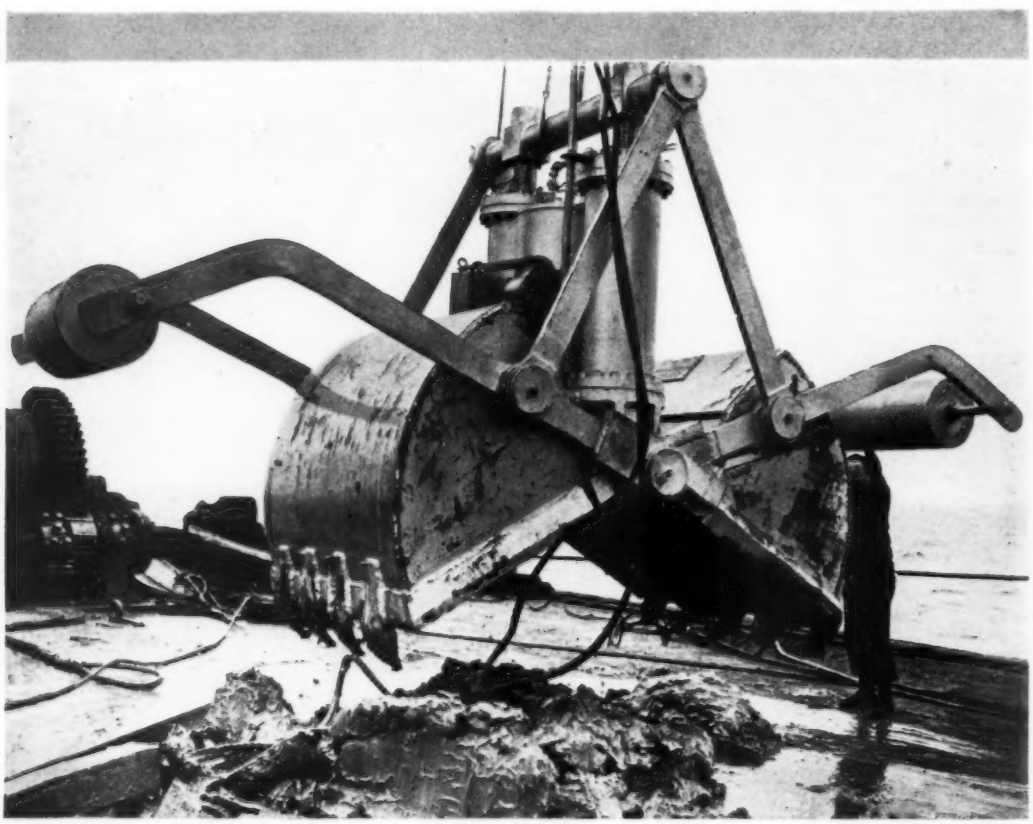


Hauling up the ten-foot brass tube with a specimen of ocean ooze. The gun is out of sight at the top

no apparatus exists today that could bring up commercial quantities from depths of three miles or more. But inventors of the future may meet the challenge. Only recently the depth record for dredging was multiplied many times when a new deep-sea "clamshell" dredge, designed by a California engineer for salvaging sunken treasure, brought up chunks of the sea bottom from 1,000 feet beneath the surface. Automatic valves harnessed the terrific water pressure at this depth to close the ten-ton jaws upon a five-ton "mouthful." And new alloys may solve the problem of fashioning cables strong enough to lower such an implement miles into the sea. To those who wonder about the excessive cost and labor of hoisting small loads of radium-bearing material so far to the surface, it may be pointed out that rich radium ores from Canadian mines isolated in the wilderness have even been flown profitably to the refinery by airplane. As a radium ore, the red mud from the sea would offer a strange contrast to the Canadian pitchblende, which resembles coal and might have escaped discovery but for the fact that some of its compounds turn lemon-yellow on contact with the air.

Valuable by-products may help to make it commercially feasible to mine the sea for radium, for the first samples obtained with Dr. Piggot's gun reveal a rich variety of other metallic elements, including gold. Whether the yellow metal can ever be extracted in paying quantities from sea water has long been a subject of speculation; now, gold from the ocean bottom enters the picture as a possible rival! In addition, the samples contain large amounts of iron and manganese—the important alloy-steel ingredient now widely discussed as a vital war material—and other metals such as copper and tin.

How did all these metals get there? Apparently the sea's bed forms the bottom of a gigantic test tube, into which the earth's streams empty an endless variety of dissolved minerals. Chemical precipitates, formed by their diverse reactions, have settled to rest in the submarine ooze and make it a treasure house of metallic ores. What gives this particular point is the rapidly *(Continued on page 238)*



If radium is mined from the sea bottom, dredges like this will probably be employed. Operated by the pressure of the water, equipment like this has been used successfully at depths as great as 1,000 feet

It's a small world when it's folded. At right, the collapsible globe is extended for use

Globe for Globe-Trotters Folds Like an Umbrella

GEOGRAPHICAL globes of the world which can be collapsed like umbrellas are an English novelty gaining in popularity among boat travelers on round-the-world cruises. In their collapsed form, the globes take up no more space than ordinary umbrellas, making them easy to carry or to stow away in steamship cabins. When a ring on the handle is pushed upward, flexible ribs bend outward to shape the fabric on which the map is printed.

Twin Racks Hold Fishpoles on Car Roof

Not a newfangled car-radio antenna, but real fishpoles. Inset shows how racks are attached

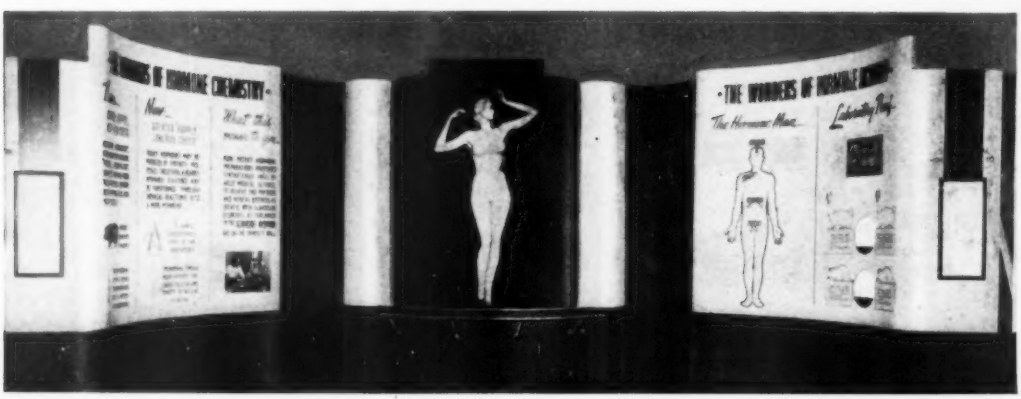
CARRYING long fishing poles on top of an automobile is made easy by new U-shape molded-plastic units having short pins that fit into holes in two rubber vacuum cups. One of these units placed near the forward edge of the car top and another at the rear provide a support for bamboo or extended metal fishpoles, whose ends are tied to front and rear bumpers by cords. The carriers will also safely support heavier objects such as iron pipes or rods, without permitting them to touch the car finish.

"Transparent Woman"

A scene in the workshop during the creation of the "transparent woman," showing the completed torso made of a synthetic plastic

GIVING spectators an animated view of human glands in action, a "transparent woman" designed by Dr. Frank H. Netter of New York City for exhibition at the San Francisco World's Fair is declared the first of its kind ever made. A synthetic plastic shell of sun-tan hue, skillfully molded to represent half of a female figure and backed by a silk projection screen, creates the illusion of peering directly into a real body. To the accompaniment of a synchronized lecture from a concealed loudspeaker, the audience sees a spot of light appear in the head to indicate the pituitary or "master" gland. Red lines race through the figure to show how the pituitary hormone or secretion controls other glands, producing new hormones in turn. Then a rapid succession of full-color slides provides enlarged "movies" of an individual set of glands at work.

Behind the scenes, the apparatus that animates the novel exhibition resembles a miniature planetarium. Nineteen midget projection lanterns flash on and off at exactly the right moments, to produce the images of various glands and of the red lines that connect them. Within a central housing revolve a pair of wheels bearing the enlarged color slides, which are alternately displayed through a swinging shutter that makes one "dissolve" into the next. Meanwhile, from time to time, another projector with a revolving color filter bathes the figure in decorative rainbow tints. Rotating contacts on an electrical timing drum operate all these projectors in time with a motor-driven dimmer for controlling the lights that vary the exterior illumination of the figure, and with an electric phonograph that delivers the running comment through the loudspeaker. The photograph below shows the unique exhibit, and the drawing on the opposite page illustrates the mechanism that operates it.



This is how the unique exhibit appears to spectators. It is now on display at the San Francisco World's Fair

Shows How Glands Work

LOUDSPEAKER
ILLUMINATED SPOT INDICATES PITUITARY OR "MASTER" GLAND
THYROID GLAND LIGHTS UP NEXT
RED LINES TRACE SPREADING INFLUENCE OF PITUITARY HORMONE
BRIGHT SPOTS SHOW OTHER GLANDS CONTROLLED BY PITUITARY GLAND
PLASTIC FIGURE IS MOLDED AS HOLLOW SHELL
SCREEN IS OPAQUE OUTSIDE SILHOUETTE OF FIGURE
REVOLVING COLOR WHEEL BATHES FIGURE IN DECORATIVE HUES
SILK PROJECTION SCREEN
MIDGET PROJECTION LANTERNS FLASH ON AND OFF TO ILLUSTRATE EACH GLAND AND TO INSERT CONNECTING LINES
THIRTY-TWO COLOR SLIDES, ON TWO REVOLVING WHEELS, GIVE ENLARGED VIEWS SHOWING DETAILS OF GLAND ACTION
TIMING DRUM SYNCHRONIZES PROJECTORS, DIMMERS, AND PHONOGRAPH
MOTOR-DRIVEN DIMMER VARIES EXTERIOR LIGHTING ON FIGURE
ELECTRIC PHONOGRAPH DELIVERS TIMED LECTURE TO ACCOMPANY EXHIBIT

Here our artist shows the complicated mechanism that demonstrates the action of the glands. Resembling a miniature planetarium, it has nineteen midget projection lanterns that throw images onto a translucent screen

Wooden spoons being cut from a roughly shaped block

Wooden Knives and Forks for Polar Explorers

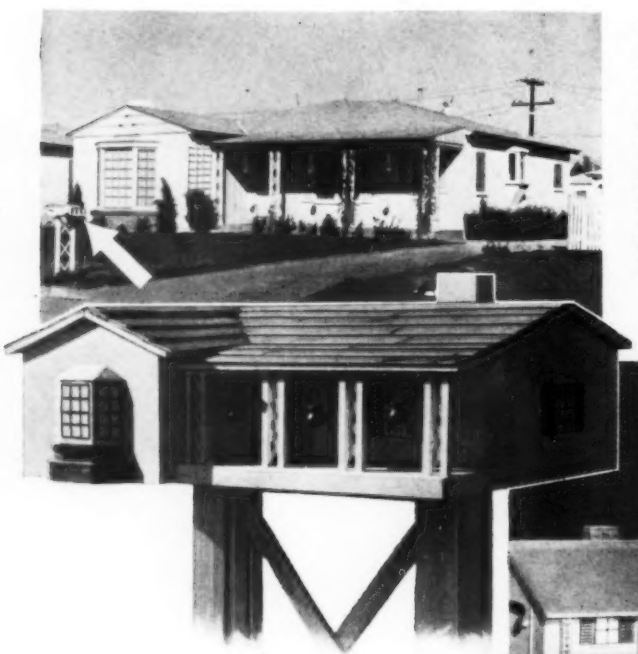
MAKING wooden tableware for use by polar explorers is a curious side line of an Oregon woodworker. From carefully selected wood, he fashions knives, forks, and spoons that will be taken along by expeditions to the arctic and antarctic. At the extremely low temperatures encountered in the polar regions, metal cutlery freezes to the hands of persons using it.

Snow Makes Spring Fever?

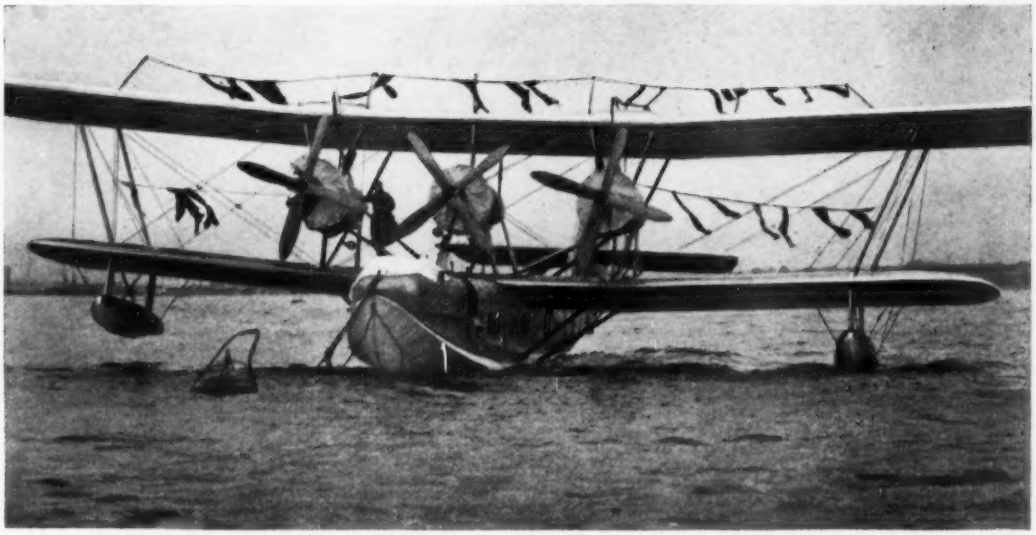
SPRING FEVER may be caused indirectly by a gaseous radium emanation released by the melting of winter snows. Observations by a French weather expert indicate that the gaseous element radon is imprisoned in snow during the winter, and is turned loose in the air in unusually large quantities when the snow melts. It is believed that this abnormal radioactivity produces a temporary stimulation of life, which is followed by the familiar spring depression and fatigue.

Mail Boxes Keep the Wolf from Her Door

FORCED to find some way to earn her living when she moved to California for the sake of her son's health, a North Hollywood woman conceived the ingenious idea of building roadside mail boxes that are miniature reproductions of the homes which they serve. Turned out by hand in her own home workshop, the model-home mail boxes are made to order, following the lines and color scheme of any particular dwelling. Many of the unique mail boxes have been built for the homes of movie stars.



This mail box is a miniature of the house it serves, as shown in the upper picture. Making such boxes is a profitable business for the California woman seen at right in her workshop

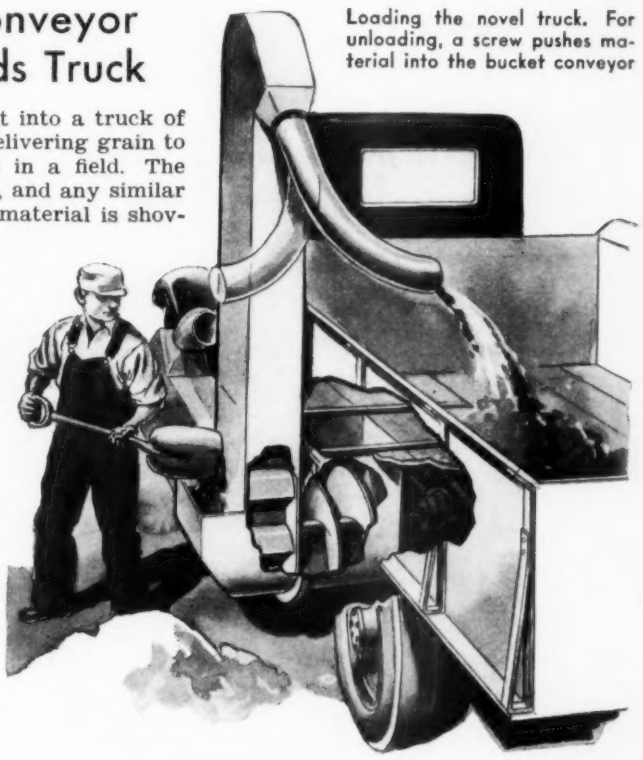


"Clotheslines" Scare Gulls off Plane

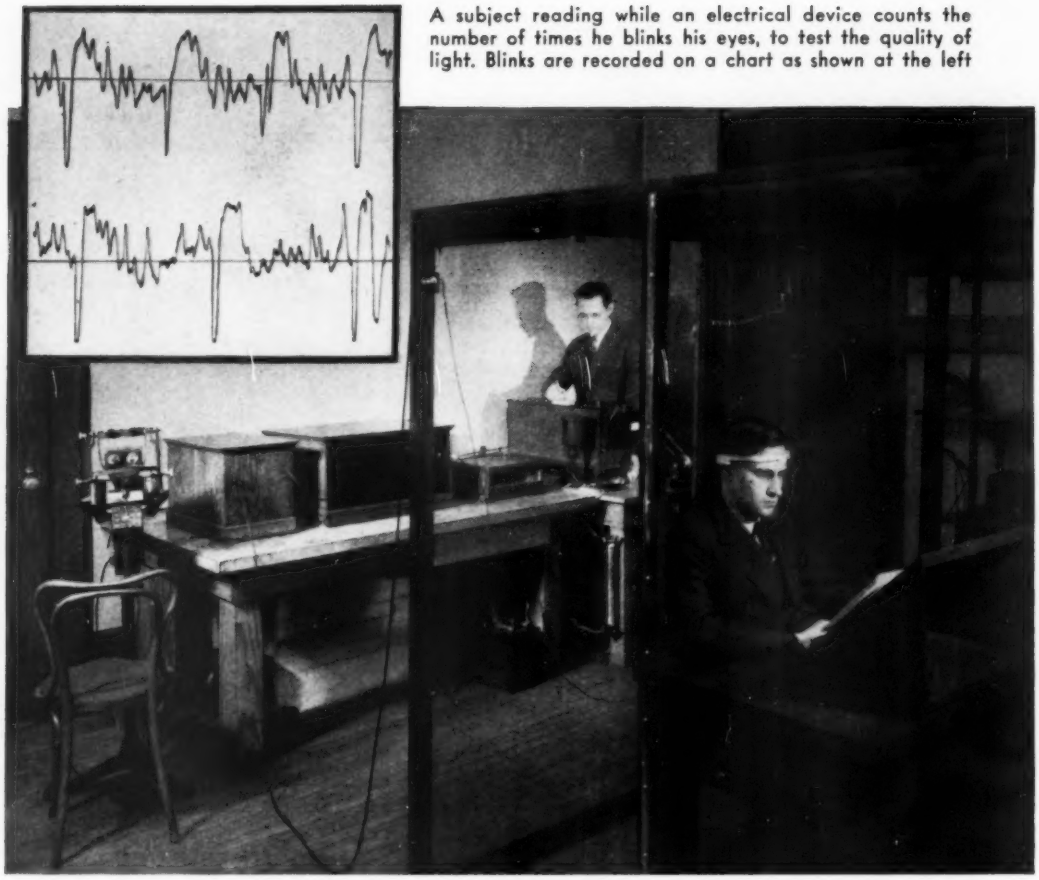
IT'S not wash day aboard the plane pictured above, though the strips of cloth fluttering in the breeze from wires above and between the wings might suggest it. Actually the flapping streamers serve the odd purpose of frightening away sea gulls, while the big flying boat rides at anchor off Southampton, England. Otherwise the marine birds will alight on the wings and take mischievous delight in pecking holes in the fabric.

Built-in Bucket Conveyor Loads and Unloads Truck

A MINIATURE grain elevator, built into a truck of new design, simplifies the task of delivering grain to the bin from a threshing machine in a field. The device will also handle sand, gravel, and any similar loose commodity. For loading, the material is shoveled into a hopper at the side of the vehicle, and a vertical bucket conveyor discharges it through a spout into the truck body. In unloading, the spout is reversed and the bucket conveyor again comes into play, fed by a screw conveyor through an opening in the truck bottom that has been uncovered by a movable slide. Power for operating both conveyors is supplied by the motor of the truck. A flanged connection allows the vertical conveyor to be tilted forward into a horizontal position for increased clearance, when not in use, permitting the truck to pass through the doorways of granaries or other buildings, and under obstructions encountered on the highway, as easily as an ordinary motor truck.



Loading the novel truck. For unloading, a screw pushes material into the bucket conveyor



A subject reading while an electrical device counts the number of times he blinks his eyes, to test the quality of light. Blinks are recorded on a chart as shown at the left

Eye Blinks Counted To Grade Lighting

A "BLINK TEST" now rates good and bad lighting for General Electric engineers. How frequently a person blinks his eyes, they have found, affords the best yardstick of visual fatigue yet discovered. In reading, you will blink more often with poorer light, smaller print, and prolonged attention. An observer with a watch could count the eye movements, but a laboratory "comfort meter" times them more accurately. Metal contacts placed on the skin, near the eyes, detect faint electrical changes in the eye muscles when the subject blinks, and these impulses are amplified and automatically recorded.

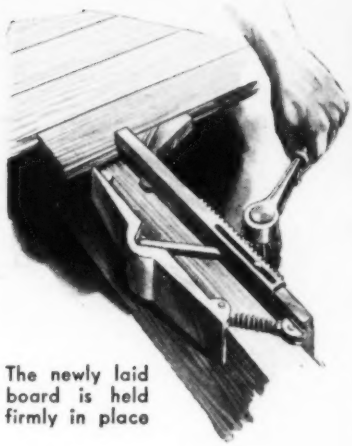
Cigarettes Pop Out from Novel Holder

CIGARETTE server and ash tray are combined in a convenient new smoking accessory. Individual compartments around its edge hold twenty cigarettes, which are pushed down against fine spiral springs by the weight of the ash-tray lid. Turning the lid, which has a hole in its rim, permits each cigarette to pop out in turn.

Filling the novel cigarette holder. When the lid is turned, a smoke pops out of the hole

Floor-Laying Tool Makes Tight Joint

LAYING floors with tongue-and-groove boards is made easier by the use of a new carpenter's tool invented by Guillermo Solomon, of Santiago, Dominican Republic. The device consists of a clamp which is placed over a floor joist. When a handle is pulled, a ratchet mechanism causes the clamp to grip the joist tightly, while a sliding arm presses the newly laid board against its neighbor and holds it firmly in place for nailing.

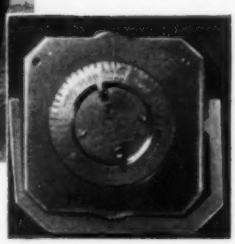


The newly laid board is held firmly in place

Novel Book Has Transparent Pages

A NOVEL type of picture book whose covers and pages are transparent was recently devised by S. T. Jonas, a Chicago, Ill., dentist. The curious volume has opaque parts of a picture arranged on each transparent page. As the "reader" turns the pages, laying one on top of the other, he builds up a picture one step at a time, or, reversing the procedure, takes the picture apart. The odd book is expected to have many applications in education, advertising, and other fields.

New Barometer Forecasts Fisherman's Luck



Instead of good or bad weather, this pocket barometer forecasts good or bad fishing. At right is a back view showing altitude-adjustment plate

FOR anglers who support the theory that fish bite better when atmospheric pressure is increasing, a Rochester, N.Y., manufacturer has brought out a barometer fitted with a special dial. The angler first adjusts the instrument for altitude, and then aligns a black line marked on a special disk in the dial center with the standard red indicating pointer. If, at a later reading, the red hand has moved to the right, fishing will be good; if to the left, it will be bad.

Flying Cameras Map

By ANDREW R. BOONE

FROM aerial photographs snapped by giant bombers soaring four miles above the earth, U. S. Army engineers are compiling maps that will serve as eyes for our armed forces if they ever have to wage a defensive war on American soil.

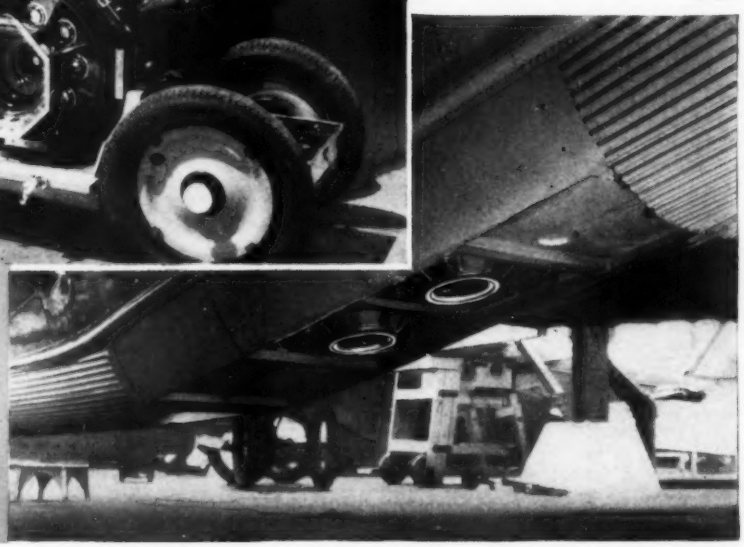
Flying out of Fort Lewis, Wash., the camera planes have recently been engaged in photographing all unmapped areas between the Cascade Mountains and the Pacific, from Puget Sound to the Siskiyou Mountains of California. With their multiple cameras they make five pictures at a crack, one straight down and four at angles ahead, astern, and to the sides. Finished prints of the photographs are sent to the 29th Engineers at Portland, Ore. Here, in two old school buildings, they are turned into topographical maps showing all important features that would figure in wartime plans. When the northwestern country has been covered completely, camera planes and map makers will move on to the Southwest, and later work their way eastward.

While the photographers are snapping the terrain from the sky, survey parties on the ground extend triangulation nets and run traverse and level lines, thus establishing definite points of known elevation which can be compared with the corresponding points in the photographs.

For the delicate task of turning the bird's-eye camera views into accurate contour maps, the engineers use two somewhat similar devices, the stereo comparagraph and the multiplex aeroprojector. Despite their formidable names, they operate on the same simple principle that enables you to judge distances with your eyes, and to see a three-dimensional image in an old-fashioned parlor stereoscope.

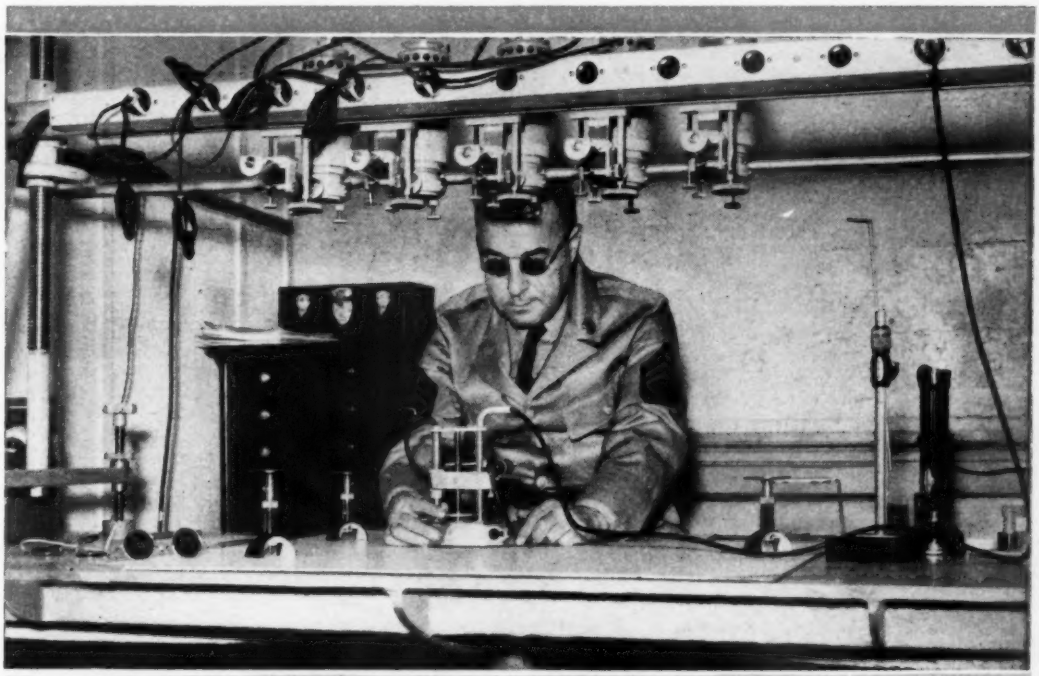
You can demonstrate the idea very easily. Hold a pencil two feet in front of your eyes. Look beyond the pencil at some distant object, and you seem to see two pencils; look at the pencil, and the distant object appears double. If you close your

A multiple-lens camera of the type used in aerial photography. It is taken to and from the plane on a special rubber-tired truck



Underside of a big bombing plane, with cameras set in its belly for mapping the ground from four miles up

America for War



In the multiplex aeroprojector, a three-dimensional image is produced by projecting two aerial photographs

right eye, the pencil appears to move to the right; close your left eye, and it seems to move to the left. The effect is caused by your eyes seeing objects from slightly different angles, or different points of view.

Mounting pictures made simultaneously by a camera's five lenses

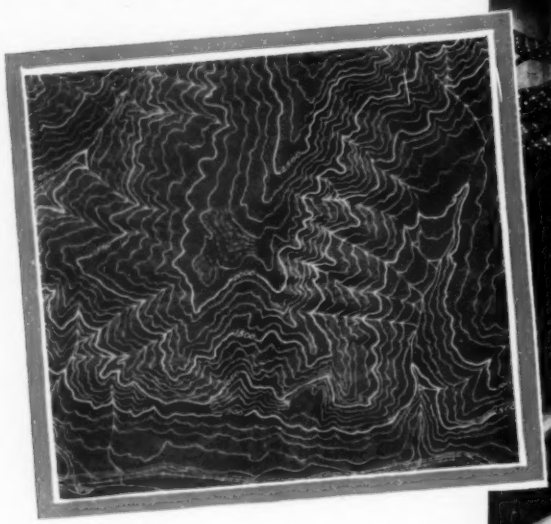
In using the stereo comparagraph, the map maker looks through an instrument resembling a stereoscope at two photographs of the same stretch of country, made from the camera plane in two different positions. What he sees appears to be a plastic relief model of the terrain, with mountains sticking upward and valleys scooped out. A "floating mark," an image projected on the focal plane by mirrors, is fused into a point whose elevation has been established by the ground survey. It is then an easy matter to follow the contour line for that level across the three-dimensional image, while a pencil attached to an arm of the device traces the corresponding line on the map itself. For other elevations, the "floating point" is raised or lowered according to a scale.

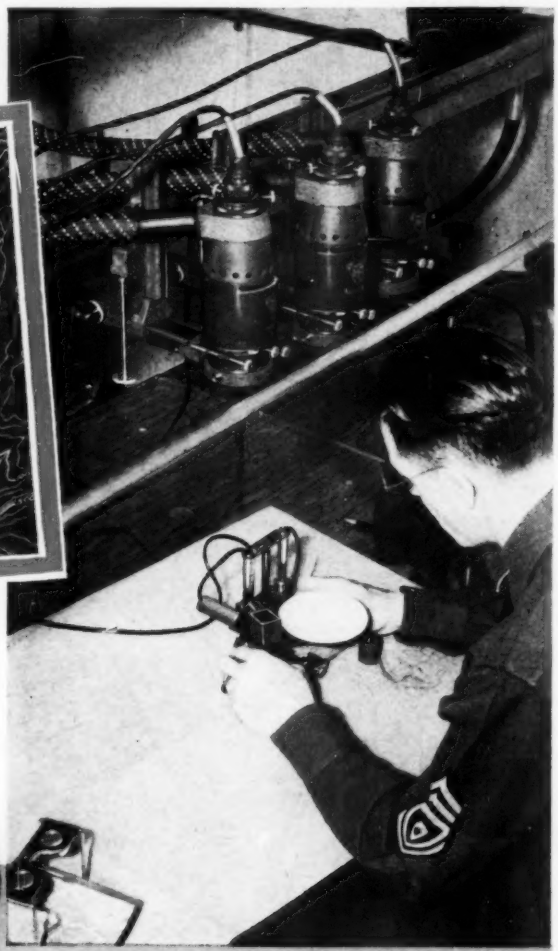
The same principle is applied in the multiplex aeroprojector, except that in this case the images of the overlapping aerial

photographs are projected directly on the mapping surface, one in blue light and the other in red light. The effect, as viewed by the naked eye, is a seemingly meaningless jumble of color, like the illustration on page 65. However, when it is viewed through spectacles with one blue lens and one red lens, hills and valleys appear as if by magic, and all the important features of the landscape are seen with startling clearness. This time the "floating point" is fixed at the proper level on a tracing stand fitted with a pencil that draws the contour lines as the stand is moved across the map.

For throwing the images on the mapping surface, projectors are mounted on a horizontal bar above the table, and can be adjusted to correspond with the positions of the camera in taking the pictures.

Using either of these ingenious new devices, a worker can map directly from aerial photographs about two square miles a day.



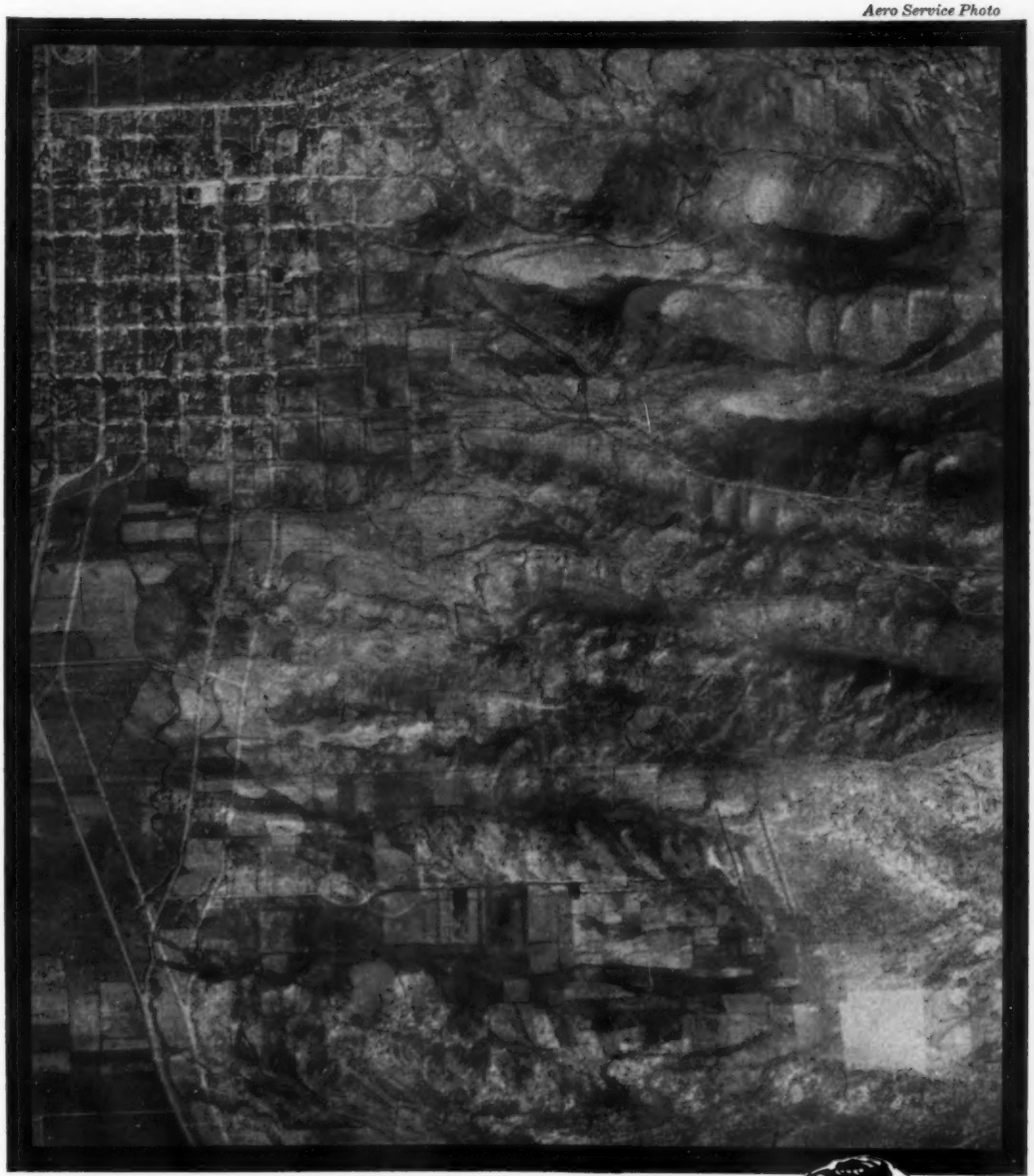


Contour map showing all topographical features. Right, tracing contours with the aeroprojector. Through colored glasses, the map maker sees a stereoscopic image of the ground

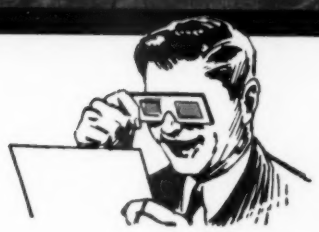
USING THE STEREO COMPARAGRAPH

Like the old-time stereoscope, this device gives an illusion of depth to matched aerial photographs seen with it. As the user traces contour lines with the "floating point," a pencil draws the lines on the map itself

Aero Service Photo



Try This Stereoscopic View from the Sky



THIS seemingly meaningless blur of colored lines is a stereoscopic image of the kind produced by the multiplex aeroprojector used by U. S. Army engineers in making contour maps from aerial photographs, as described in the preceding pages. To see how it works, make a simple spectacle frame out of cardboard. Cover the right eye hole with blue transparent cellulose wrapping material, and the left eye hole with red. Now hold the picture about a foot away from your eyes and look at it through the spectacles. You will see mountains and valleys standing out of the page with startling effect. The area shown is in Utah.

COLOR MAGIC WITH POLARIZED LIGHT

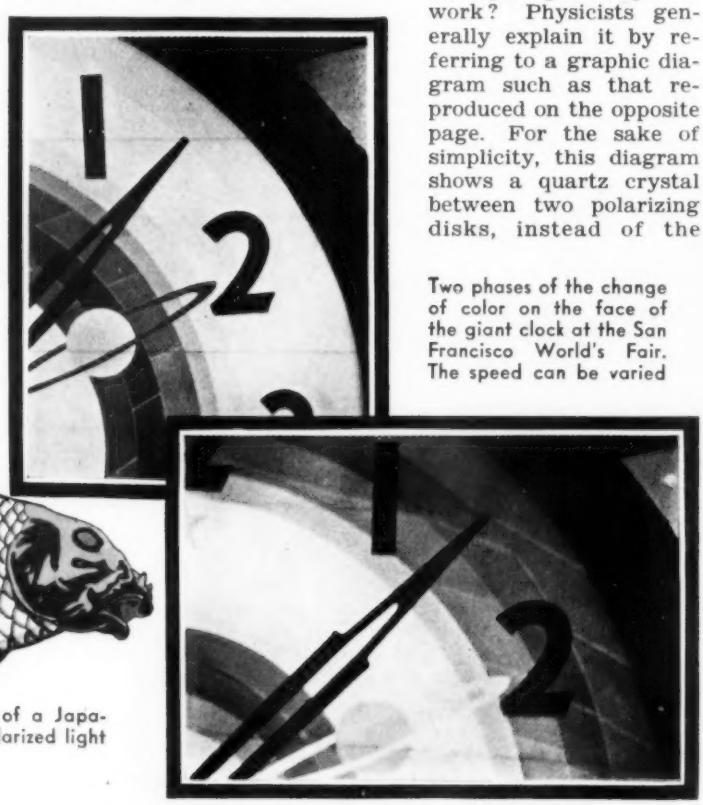
By E. W. MURTFELDT

BLAZING with brilliant, ever-changing colors that rival the hues of the rainbow, the illuminated face of a giant electric clock is attracting crowds to an exhibit of timepieces at the San Francisco World's Fair. Visitors, curious to know how this spectacular effect is obtained, are amazed to learn that this gleaming disk of light, sparkling with an intricate, moving pattern of colorful stars and concentric circles, is produced not by any complicated arrangement of colored bulbs, projectors, and revolving filters, but merely by plain white light, and strips of transparent cellulose mending tape sandwiched between two practically colorless disks.

What, they ask, is the magic element that transforms these simple materials into a myriad of whirling rainbows? Polaroid, the crystalline substance invented by Edwin H. Land, Boston scientist, that produces and controls polarized light (P.S.M., Apr. '36, p. 20), provides the key to the mystery. First placed on the market only a few years ago, this polarizing material is already well known through its extensive use in sun glasses, camera-lens filters, desk lamps, train windows, and microscopes. In industry, it is used to spot invisible strains in glass and other transparent materials, much as X-ray apparatus is employed to track down hidden defects in metal parts.

But few people today know that polarizing disks can be made to create vivid colors such as those that shimmer on the face of this mammoth clock. Yet Fford Burchell, New York City expert who built this magic dial, predicts that "polarized color" will soon sweep the country, creating startling and revolutionary lighting effects for outdoor signs, advertising displays, interior decoration, and theater stage sets, to name only a few applications.

Exactly how does this important but mysterious lighting development work? Physicists generally explain it by referring to a graphic diagram such as that reproduced on the opposite page. For the sake of simplicity, this diagram shows a quartz crystal between two polarizing disks, instead of the



Two phases of the change of color on the face of the giant clock at the San Francisco World's Fair. The speed can be varied

Colorful designs, like this copy of a Japanese print, can be made with polarized light

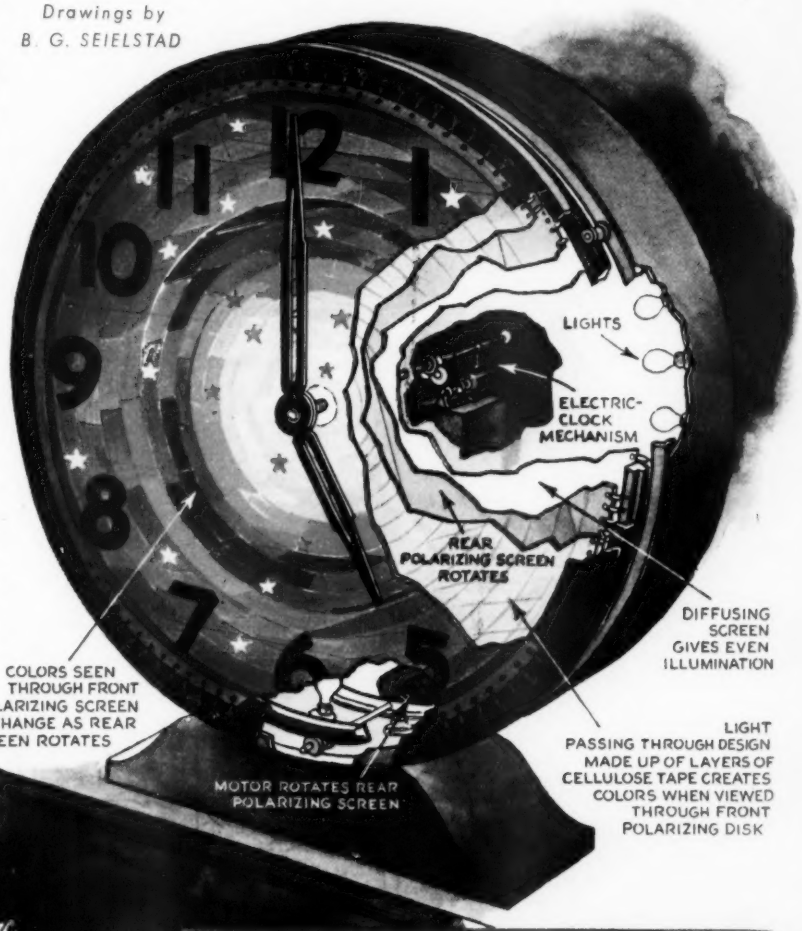
mending tape used in the clock dial, for the tape acts on polarized light in a more complicated way, although the general principle is the same.

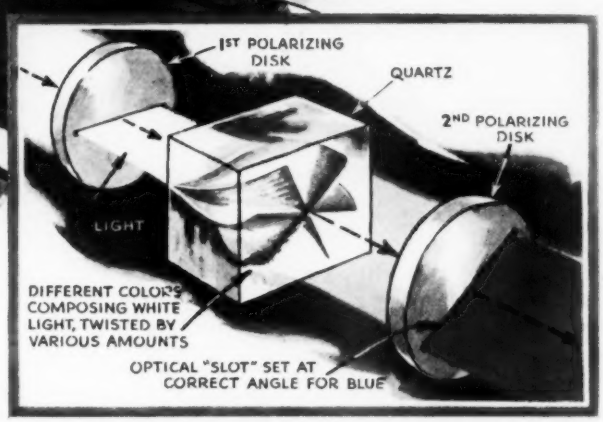
With the diagram as a visual guide, follow a beam of light on its path through the first disk, into the crystal, and out through the second disk. Vibrating in all directions, the beam strikes the first polarizing disk, which acts like an opaque circle with countless optical slots cut in it, letting through only light vibrating in a single plane. Next, the beam enters the quartz crystal, where the different colors that make up this polarized white light are "twisted" by various amounts, each color emerging at a separate angle, something like a wheel with spokes painted in various colors.

Only the particular color emerging at the same angle as that of the optical slots in the second polarizing disk will pass through and become visible on the other side. If you rotate the disk, the colors change as the optical slots coincide first with the angle of one color and then with that of another.

This, in simplified form, is the general principle employed to change the plain face of this huge clock into a brilliant galaxy of colors. The clock itself is built like a mammoth five-layer cake set up on edge, with

Drawings by
B. G. SEIELSTAD


LIGHTS
ELECTRIC-CLOCK MECHANISM
REAR POLARIZING SCREEN ROTATES
DIFFUSING SCREEN GIVES EVEN ILLUMINATION
COLORS SEEN THROUGH FRONT POLARIZING SCREEN CHANGE AS REAR SCREEN ROTATES
LIGHT PASSING THROUGH DESIGN MADE UP OF LAYERS OF CELLULOSE TAPE CREATES COLORS WHEN VIEWED THROUGH FRONT POLARIZING DISK
MOTOR ROTATES REAR POLARIZING SCREEN


1ST POLARIZING DISK
QUARTZ
2ND POLARIZING DISK
LIGHT
DIFFERENT COLORS COMPOSING WHITE LIGHT, TWISTED BY VARIOUS AMOUNTS
OPTICAL "SLOT" SET AT CORRECT ANGLE FOR BLUE

KALEIDOSCOPE ON A CLOCK'S FACE

Cut-away drawing above shows how the odd color clock is constructed. At right, diagram explains how color is produced from white light by quartz and polarizers

Mounting cellulose tape in a pattern to give the desired color effect. Circle shows the transparent material being cut to shape

each layer measuring about six feet in diameter.

The bottom, or back, layer serves as a circular light box, with twenty standard light bulbs arranged around its inside rim. In front of this light chamber is a diffusing screen that spreads the illumination evenly over every part of the dial. The third layer, more like an icing, is a thin polarizing film. This is the disk responsible for the changing colors of the clock face, since it is slowly revolved by an electric motor with a rheostat control to regulate its speed.

Layer No. 4 is a disk of transparent acetate material on which is mounted a pattern built up of about 1,000 strips of the cellulose tape. These are laid down in from one to six thicknesses, and set so that the grain of the material lies at varying angles.

Finally, the second polarizing disk, fixed in a stationary position, forms the top layer of the "cake," which is garnished with black hour numerals, and with the two moving hands.

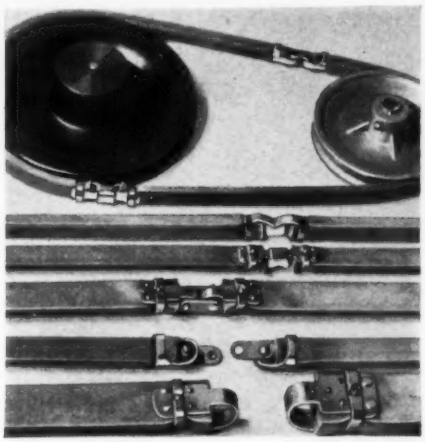
How polarizing disks are used to show the stresses set up in transparent materials

The most delicate part of this polarized color process lies in mounting the cellulose tape in designs that will produce a balanced array of colors. A pattern is first drawn on paper to serve as a guide. Then a sheet of clear acetate material is placed over it. On this, cellulose tape is cut and pasted down over each section of the design, following a chart that tells what colors will be obtained with any number of tapes at given angles.

The skill with which this work is done is evidenced not only by the spectacular clock dial, but also by an amazing group of moving color displays in a demonstration room at the Burchell laboratory in New York. These include a star design that whirls through a dazzling spectrum of color, a flower pattern with petals that shift slowly from red through green and blue to a deep purple, and a fish, copied in amazing detail from an old Japanese print, with iridescent scales that shimmer in a thousand delicate hues.

New Belt Couplings Make Strong Joints

COUPLINGS for V-type machine belts, recently placed on the market, are said to maintain the full original strength of belts that have been cut to a desired length. After a belt is cut to size, a special tool is used to fasten steel fittings over the belt ends with a viselike grip. The metal ends are joined together with rawhide links or with self-lubricating metal links and graphite-covered pins.



Rawhide links or permanently lubricated pins may be used to fasten the couplings

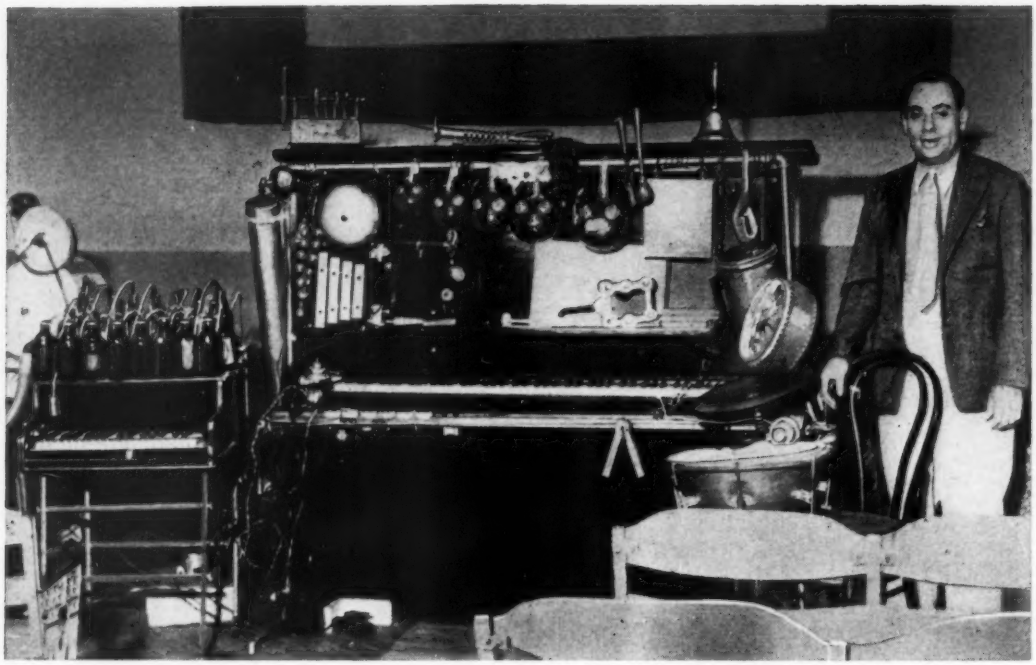
"Meter" Selects Hobby Books

WHEN a home-workshop fan presses the button marked "Woodwork" on the sloping panel of a novel "Hobby-O-Meter" installed in the Chicago, Ill., public library, a light flashes on in one of the windows in a vertical frame to illuminate selected book titles on the subject. Fifteen hobbies are represented.

Huge Footprint Is Discovered in Coal Shaft

A GIGANTIC footprint forty-two inches long and three feet wide, believed to be that of some prehistoric monster, was recently discovered in a subterranean shaft at the Black Diamond coal mine in the state of Washington. The mammoth print was first noticed by W. J. Evans, mine superintendent, during an inspection trip. A ten-foot shale slab that fell from the shaft ceiling uncovered the print.

A mine worker examines the clawlike footprint found on the mine roof



Junk Yard Yields Parts for Odd Organ

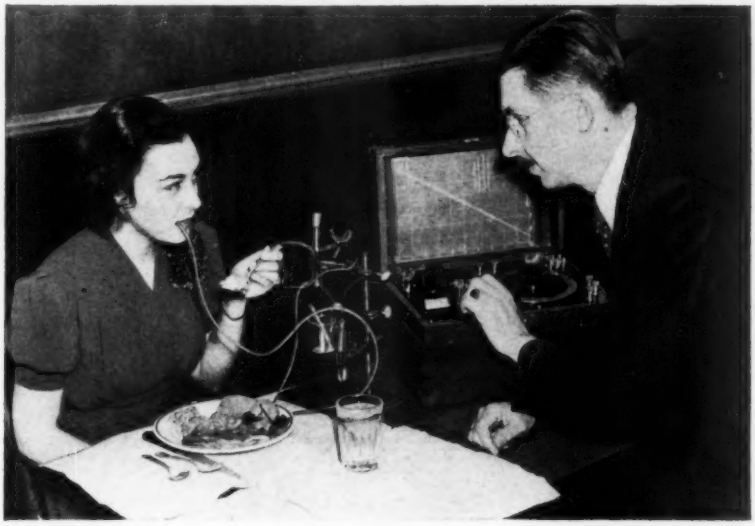
DISCARDED bottles, an old vacuum-cleaner motor, sections of inner tubing, and other objects salvaged from the scrap heap comprise the parts of a unique junk-yard organ recently exhibited at Atlantic City, N. J. Individual notes are sounded by air from the cleaner motor blowing across small holes in the caps of bottles tuned by partly filling them with water. Supplementary noise makers are attached to the organ's console.

This device reproduces rock pressures far under the ground

Rock Squeezer Shows Origin of Mountains

ROCK samples are subjected to the terrific pressures they undergo normally in the interior of the earth at depths of twenty miles or more, in a machine used by Dr. David Griggs, of the Harvard University geophysical laboratory, in geological experiments that reproduce on a miniature scale the manner in which mountains were formed by the upheaval of the earth's crust. Under the tremendous pressure produced in the laboratory device, different rocks show greatly varying resistances—limestone, for example, breaking up and disintegrating long before quartz. Some rock specimens actually begin to flow like thick sirup when pressures become strong enough. Although the main purpose of the study is to determine the exact changes which occur in rock under heavy pressure, the experiments may yield valuable information for engineers.

Stomach Meter Aids Study of Digestion



While the subject eats, a meter records acidity changes inside the stomach

SUBJECTS who don't mind the inconvenience of dining after having swallowed an electrode at the end of a long rubber tube, are solving mysteries of digestion at the Philadelphia College of Osteopathy. Through the tube, wires lead to an electric meter that constantly records acidity changes in the stomach. One enthusiastic volunteer actually ate his way through college; paid two dollars every time he gulped down the "antimony gastric electrode," he also got his meals free, thus saving on his board bill.

Corkscrew Puts Leverage on Stubborn Stoppers

EVEN the most stubborn cork is said to be tamed by the powerful leverage of a new corkscrew. Inserting the screw in the cork, by turning a winged key, raises a pair of geared arms to a horizontal position. Push the arms down again, and out comes the cork, under pressure applied through a flange that fits over the neck of the bottle. The two operations are shown in the pictures below.

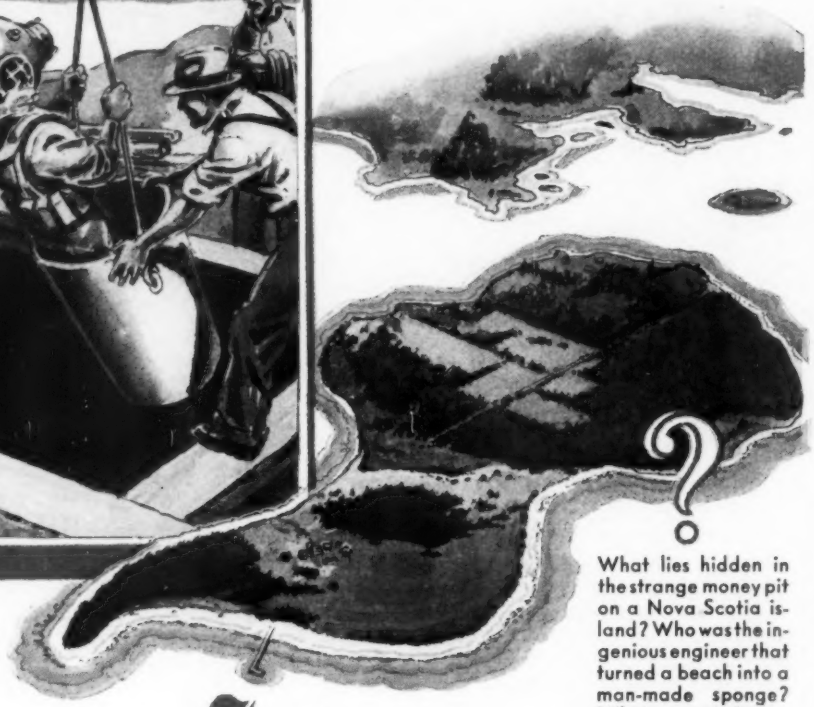
After the screw is inserted, as below, pressure on the two horizontal levers draws out the cork

Roller Spreads Out Powder for Scrubbing Floors

PUSHED like a lawn mower over a floor to be scrubbed, as shown in the illustration above, a new labor-saving tool automatically distributes scouring powder at the proper intervals. Designed especially for use in large buildings, the implement carries the cleaning compound within its hollow roller. The powder spills in turn from each of a number of slots at every revolution, assuring uniform spacing over the surface to be scrubbed.

Every New Effort To Solve This Riddle of the North Has Made It More Puzzling

The 1909 expedition used deep-sea divers to explore the pit



What lies hidden in the strange money pit on a Nova Scotia island? Who was the ingenious engineer that turned a beach into a man-made sponge? What secret is recorded on a parchment inside the vault?

Mystery Island

BAFFLES TREASURE HUNTERS

ONE day, early in the year 1893, a young insurance salesman in Amherst, Nova Scotia, listened to a tale of buried treasure. Nearly a century before, three boys had explored a "haunted" island off the Nova Scotia coast, an island covered with exotic oaks with elmlike tops. Here they stumbled upon a curious depression in the sod. Digging near the spot, successive parties of treasure hunters had uncovered riddle after riddle.

When they sank a shaft, a dozen feet in diameter, where the sod was depressed, they encountered strange platforms and markers at ten-foot intervals. At 100 feet, salt water rushed in and flooded the pit to a depth of sixty feet. On the shore of the island, the workers uncovered tons of coconut fiber. Their core drills, plumbing the "money pit," brought to the surface fragments of what appeared to be chests and casks of heavy wood. Finally, they discovered a beach which long ago had been excavated and turned into a vast, artificial sponge that flooded a subterranean treasure stronghold with an endless river of sea water.

The tale ended with the failure of all efforts to recover the hoard from its drowned hiding place—just as the story ended in the first installment of this series, which appeared in the last issue of POPULAR SCIENCE MONTHLY.

But the young insurance salesman, Frederick L. Blair, kept puzzling over the mystery

By EDWIN TEALE

of this treasure island of the north. What lay at the bottom of the pit? Who had expended so much time and energy secreting it there?

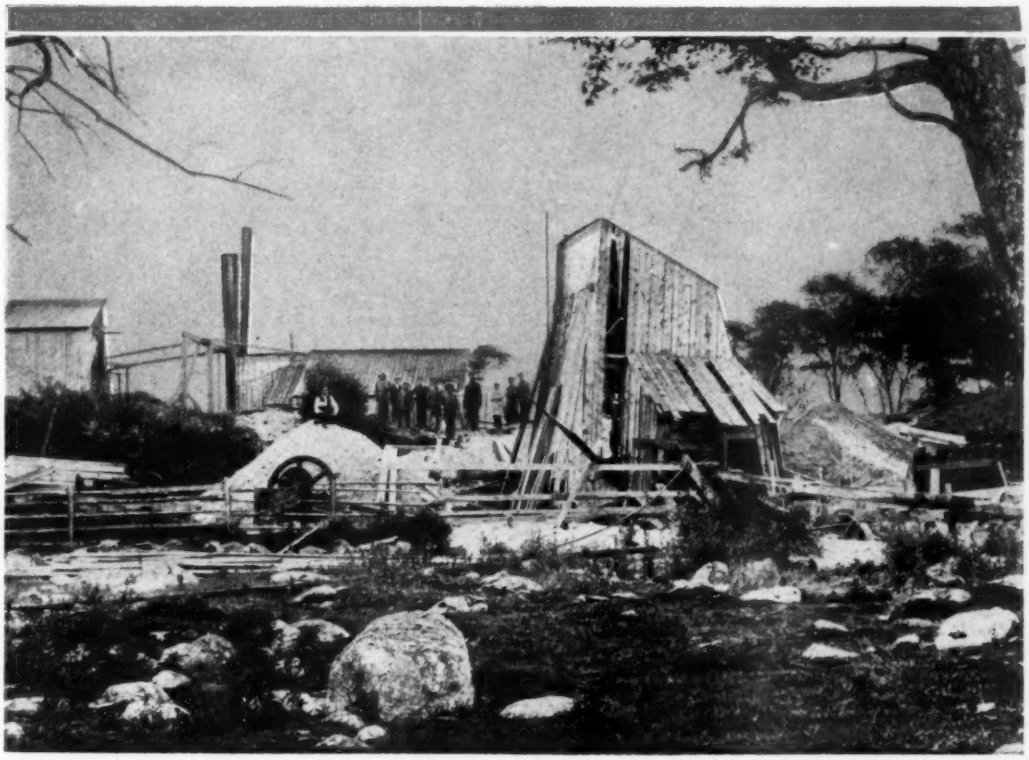
The upshot of this puzzling was the formation of a new Oak Island Treasure Company which began, in 1895, the most extensive explorations of all.

A hundred men were hired; barracks and cookhouses were erected on the island; mining experts were employed to direct the work. The first point of attack was the spot where, so many years before, two oxen had plunged into the earth when the ground gave way beneath their feet. Digging downward, the workers discovered a well-defined pit, thought to have been the air shaft used by the ancient excavators when they cut the water tunnel from the beach to the treasure cache. At fifty-five feet, sea water rushed in and the workers had to shift their attack once more to the "money pit."

During the work of one of the previous companies, the whole bottom of this pit had fallen in when a horizontal shaft was run across beneath it. Now, when the workmen cleared out the pit to a depth of 111 feet, they reported the discovery of the inland end of the water tunnel. It was said to be about two and a half feet in diameter and filled with bowlders of varying size. This mass of rocks prevented the walls of the conduit from collapsing, and at the same time the spaces between the bowlders permitted the water to flow through.

This discovery, however, still left the perennial puzzle: Why had the diggers gone to such trouble and how did they expect to recover the treasure themselves? One answer was that the last of the underground platforms was connected in some way with a water gate. The original searchers, damaging the platform by driving an iron bar into it, had unloosed the flood. Those who held this view argued that the mystifying succession of platforms had been placed in the pit to prevent the earth from settling and breaking down the final barrier.

Unable to pump the flow of water out of the pit, the 1895 company tried to "turn off the faucet" by dynamiting the tunnel near the beach. Five times they drilled holes seventy feet deep and lowered high explosives into them. The fifth time, 165 pounds of dynamite was set off in one huge blast. For



This old photograph shows workmen and equipment of the 1895 expedition. Although this company failed after several years of operation, it discovered some important clews to the riddle of the money pit

One of the riddles of the treasure pit—a piece of parchment bearing faded writing in ink—was brought up by a core drill

Capt. H. L. Bowdoin, a famous engineer-adventurer of the early twentieth century. He commanded the expedition sent to Oak Island in 1909 by a company which included Franklin D. Roosevelt

minutes afterwards, water in the money pit boiled and foamed. But the flow continued only slightly diminished.

And now we come to one of the most bewildering discoveries of all.

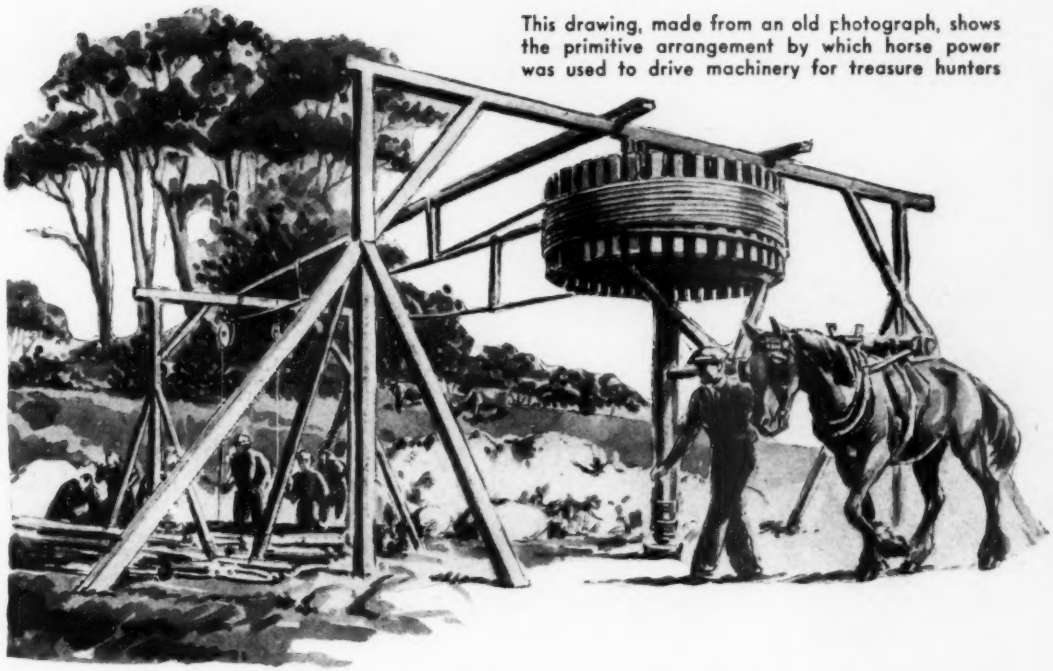
Once again, the treasure seekers sought to plumb the mystery of the pit bottom with drills and augers. Using a 2½-inch drill, operating inside a three-inch pipe, they reached a depth of more than 150 feet. William Chappell, now an old man and a resident of Sydney, Nova Scotia, was in charge of the work. According to his sworn affidavit, the drillers once more struck what appeared to be an oaken chest filled with loose coins and metal bars.

Each time the drill was pulled up, every fragment adhering to it was removed and examined under a magnifying glass. In this way, bits of oak and other fragments were discovered. Then, one evening, when the drill was brought up for the last time, T. Perley Putnam, one of the officials, made his extraordinary discovery.

At first glance, his find appeared to be a seed about the size of a kernel of rice. More careful examination, later verified by scientists, showed it was a minute fragment of parchment. Less than half an inch long, it contained slanting lines of black ink forming what might be "vi" or "wi." Still in the possession of Frederick L. Blair, this tiny link with the past forms one of the strangest of the many strange discoveries on Oak Island. A few months hence, when the latest expedition headed by a New Jersey engineer tackles the mystery of the island, the riddle of this buried missive, written no one knows when or where, may at last be solved.

Another discovery, made in 1897, was almost as sensational as the finding of the fragment of parchment. At a depth of more than 150 feet, the boring apparatus cut into rocklike material some three feet thick. Cores were submitted to A. Boake Roberts & Company, a firm of analytical chemists in London, England. No information was given the scientists as to the source of the material. Weeks later, their report reached Nova Scotia. "In our opinion," it stated, "the sample is cement which has been worked by man."

This discovery brought a host of speculations in its train. Did the mysterious island contain a subterranean vault of crude concrete? Had a floor of artificial rock been laid down by the ancient workmen to keep the flood of sea water from spreading underground? Neither question could be answered. The company dug hole after hole around the money pit, hoping vainly to drain away



This drawing, made from an old photograph, shows the primitive arrangement by which horse power was used to drive machinery for treasure hunters

the flood. Thus dissipating its funds, it retired from the scene, leaving the enigma of buried treasure as far from solution as ever.

The next chapter in the story of Oak Island is outstanding because one of the men connected with the search for buried treasure was a future President of the United States, Franklin D. Roosevelt.

At the time, Roosevelt was a young lawyer who had been admitted to the bar two years before. His mother's summer home on Campobello Island, New Brunswick, was near enough to Nova Scotia for the story of Oak Island and its mystery to be a familiar one. In 1909, with several friends, including Duncan G. Harris, Frederick Childs, and Albert Gallatin, Roosevelt organized a new treasure company. The members raised $5,000 and planned, partly as a lark, to follow the lure of buried gold during the summer. The unique feature of their search was the use of deep-sea divers to explore the murky depths of the drowned money pit beneath the water level.

As a young lawyer of twenty-seven, Franklin D. Roosevelt was fascinated by the strange story of Oak Island and joined a treasure hunt

On August 18, 1909, the expedition set sail from New York City. Roosevelt was detained by business but later made several trips to the northern island. Actual work at the money pit was under the direction of Capt. H. L. Bowdoin, a noted adventurer-engineer of the time. The divers, incased in their rubber suits and metal helmets, were lowered at the end of winch-operated cables into the black depths. After several hazardous journeys of the kind, this phase of the attack was abandoned. But the attack upon the mystery of the island was continued with drills. Twenty-eight times during the last week of operations, the drill bored downward to more than 150 feet. Cores brought to the surface from this depth were later submitted to scientists at Columbia University. They reported, one of the men connected with the expedition told me, that the samples were formed of "rocklike material apparently man-made."

If they *were* man-made, who were the men who made them? An answer to that query would give important clews to what lies buried on Oak Island. At the time of the 1909 expedition, Roosevelt and his companions in the venture believed that the pit might contain the crown jewels of Louis XVI.

The *(Continued on page 234)*

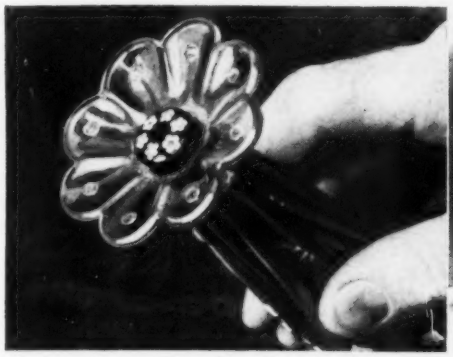
Climbers Live High in Mountain Hotel

OVER 13,000 feet above sea level, nestled in a pocket on the slope of 18,500-foot Mount Elbrus, the highest peak in Europe, one of the loftiest hotels in the world has recently been completed by the Russian Government for the benefit of mountain-climbing enthusiasts. Constructed with a rounded, streamline exterior shell as a protection against high winds, the mountain inn has accommodations for 200 persons and provides all modern conveniences, including running water, restaurant service, and electric heating. Supplies are brought up the mountain over a ten-mile road that is a noteworthy feat of highway engineering, since about two miles of its length is laid over icy glaciers, and the remainder winds in and out of rocky gorges and ravines. The photograph above shows the hotel just after completion.

Taking lumber up Mount Elbrus for building the hotel seen completed above

Standing Umbrella Needs No Umbrella Stand

UMBRELLAS of a type recently placed on the market will stand upright by themselves for drying or storage. The novelty, as pictured in the photographs reproduced below and at the right, is a standard umbrella fitted with a broad tip made of unbreakable glass molded into an attractive rosette. When a user comes in out of the rain, the umbrella can be stood on its tip to drain properly if an umbrella stand is not available.



A broad glass tip holds the umbrella upright

Wood Is New Material for Women's Hats

WOMEN'S hats grow on trees. That statement is now literally true, since a New York City millinery firm recently started weaving headgear out of thin strips of mahogany, walnut, birch, and other woods. The wooden sheets are processed with plastic materials and woven into various patterns and designs.

Making a hat from wood. At left, flexible strips of the material are being dried after processing

Portable Tire X-Rayer Shows Nails and Cuts

Nails, glass, bruises, and other tire hazards are instantly spotted, as in the inset, in the direct viewer of this X-ray machine just devised

AUTOMOBILE tires are X-rayed for hidden nails, bruises, and similar dangers by the novel portable apparatus pictured at the left. Introduced by Firestone engineers, the X-ray unit is rolled under a jacked-up wheel, and the tire is viewed section by section, just as a physician examines the body of a patient with a fluoroscope. In an experimental test of 2,000 automobile tires with the apparatus, experts discovered 2,049 nails and tacks, 2,099 pieces of glass, and 2,197 rocks and pebbles lodged in the tread or body.

Office on Wheels Keeps Employees Close to the Job

TO SAVE time and footwork on the part of employees, officials of a German museum in Munich rigged an office on wheels that could be rolled through the corridors and exhibition rooms during an inventory of museum displays. Desks, typewriter, wastebasket, and bench were mounted on a caster-wheel hand truck, as shown in the photograph at the right. A museum attendant pushed the mobile office from one exhibit to the next.

German museum workers speeding up an inventory with the mobile office

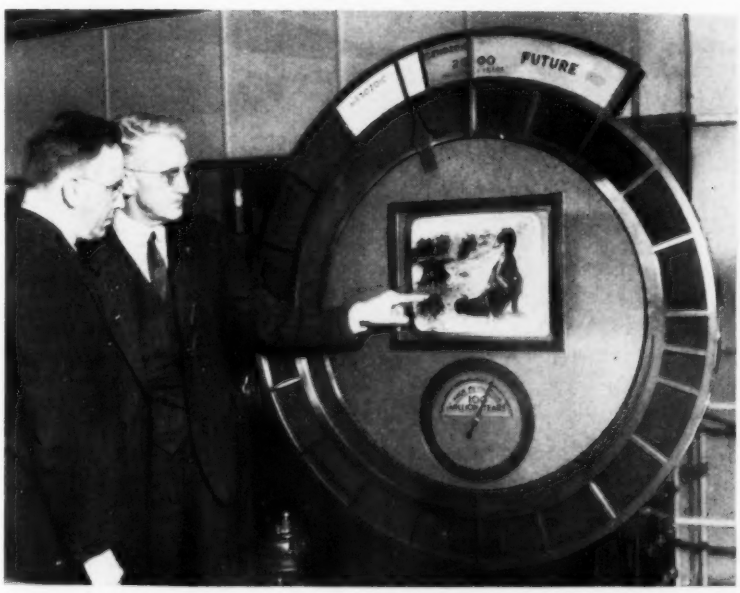
Dart-Shooting Fish Gun Has Pistol Grip

ANGLING with a dart gun, a sport that has steadily increased in popularity, especially along the shores of the Mediterranean Sea in France and Italy, is expected to be improved by the recent invention of a fishing gun that is fitted with a pistol grip so that the weapon may be aimed and fired like a rifle. Placed midway along the length of the gun, which resembles a hollow fishing rod, the pistol grip has a trigger for releasing the spring mechanism to fire a sharp, dartlike projectile that drags a line in its wake from a reel mounted a short distance in front of the grip. The weapon may also be used under water, when the angler wears special goggles that enable him to see the fish.

For aiming, the dart gun is held like a rifle by its pistol grip and reel. At left, the recovered dart is being inserted for another shot

Clock Ticks Off World's History in Four Minutes

A CLOCK whose hand races through 2,000,000,000 years in four minutes is on display at the Hall of Science, at the San Francisco, Calif., World's Fair. Designed to give visitors an idea of the geological ages of the earth's existence, the history clock has a central screen on which representative scenes of each geological age are projected as the moving hand points to its name lighted up on the clock rim.

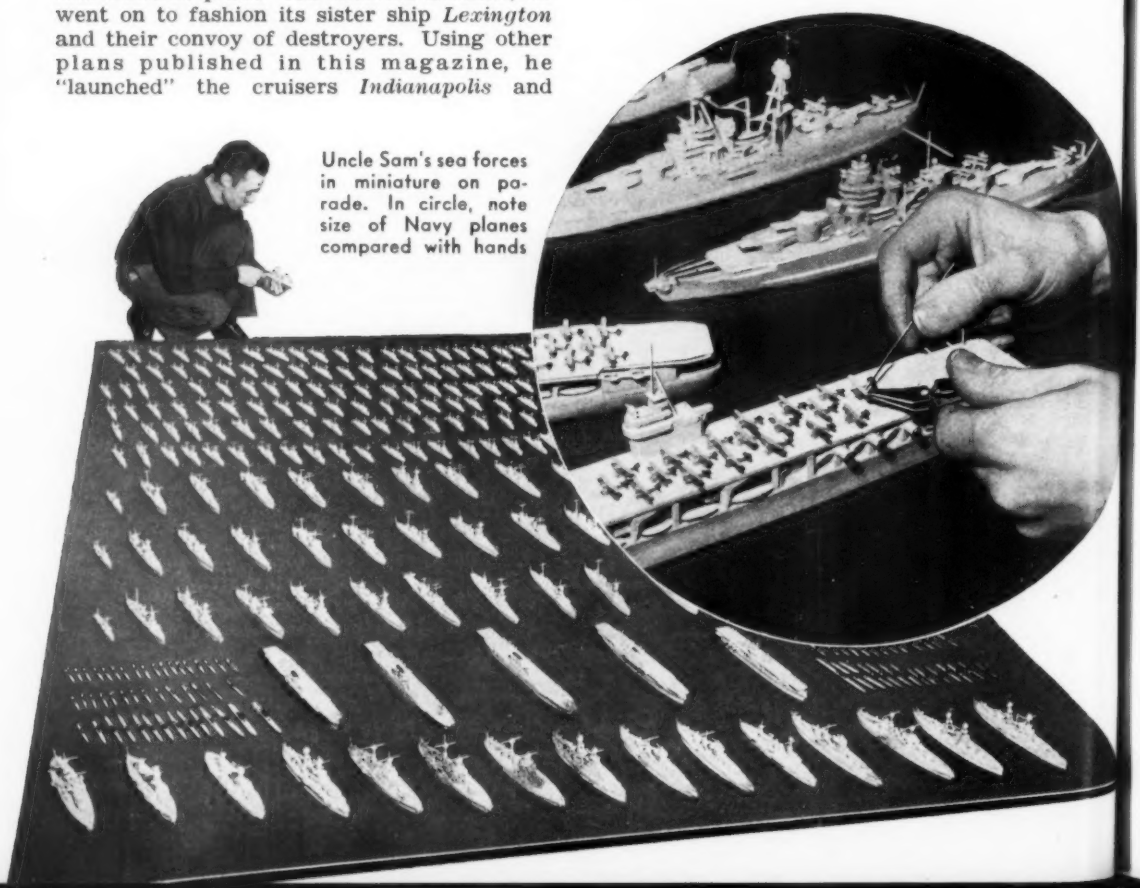


Typical scenes flash on a screen as the clock hand points to different eras

Gunther in his "shipyard" where he built the models that form his navy

Model Maker BUILDS A Midget Navy

CARRYING out his own private "armament program," Charles A Gunther, of New York, has built the whole U. S. Navy in miniature. He began by building a pine model of the aircraft carrier *Saratoga* from POPULAR SCIENCE plans. His interest aroused, he went on to fashion its sister ship *Lexington* and their convoy of destroyers. Using other plans published in this magazine, he "launched" the cruisers *Indianapolis* and *Tuscaloosa*, and then the battleships *Texas* and *New York*. News photographs and illustrated naval manuals helped him to complete his 347 scale models of the Navy's fighting craft. All battleships, carriers, and cruisers have their full complement of planes, and other vessels are finished authentically to the last practicable detail. Gunther found the battleships most difficult of all to model, several of them requiring two weeks or more to finish. He used tweezers to assemble the tiny parts of the airplanes, and each plane is painted and striped with the proper colors and markings. Placed end to end, the vessels would form a procession more than 200 feet long.



Uncle Sam's sea forces in miniature on parade. In circle, note size of Navy planes compared with hands

Transcontinental Planes Get Static Suppressers

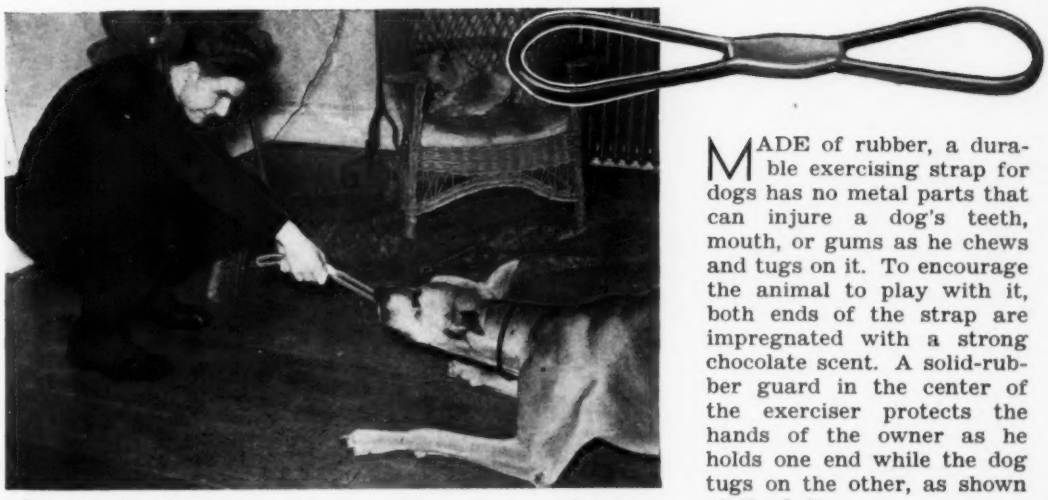
STATIC forming on the surfaces of airplanes and interfering with radio reception is suppressed by a discharging unit recently developed (P.S.M., Jan. '39, p. 240) and now in regular use on transcontinental planes. The photograph shows the suppresser removed from its housing cylinder in the plane's tail.

Golf-Ball Retriever Fits on Club Head

CLIPPED to the metal shank at the head of a golf club, a new scoop-net attachment makes it easy to retrieve golf balls driven into a pond, or other water hazard. The unit can be attached or detached quickly, and carried conveniently in a pocket or a golf bag.

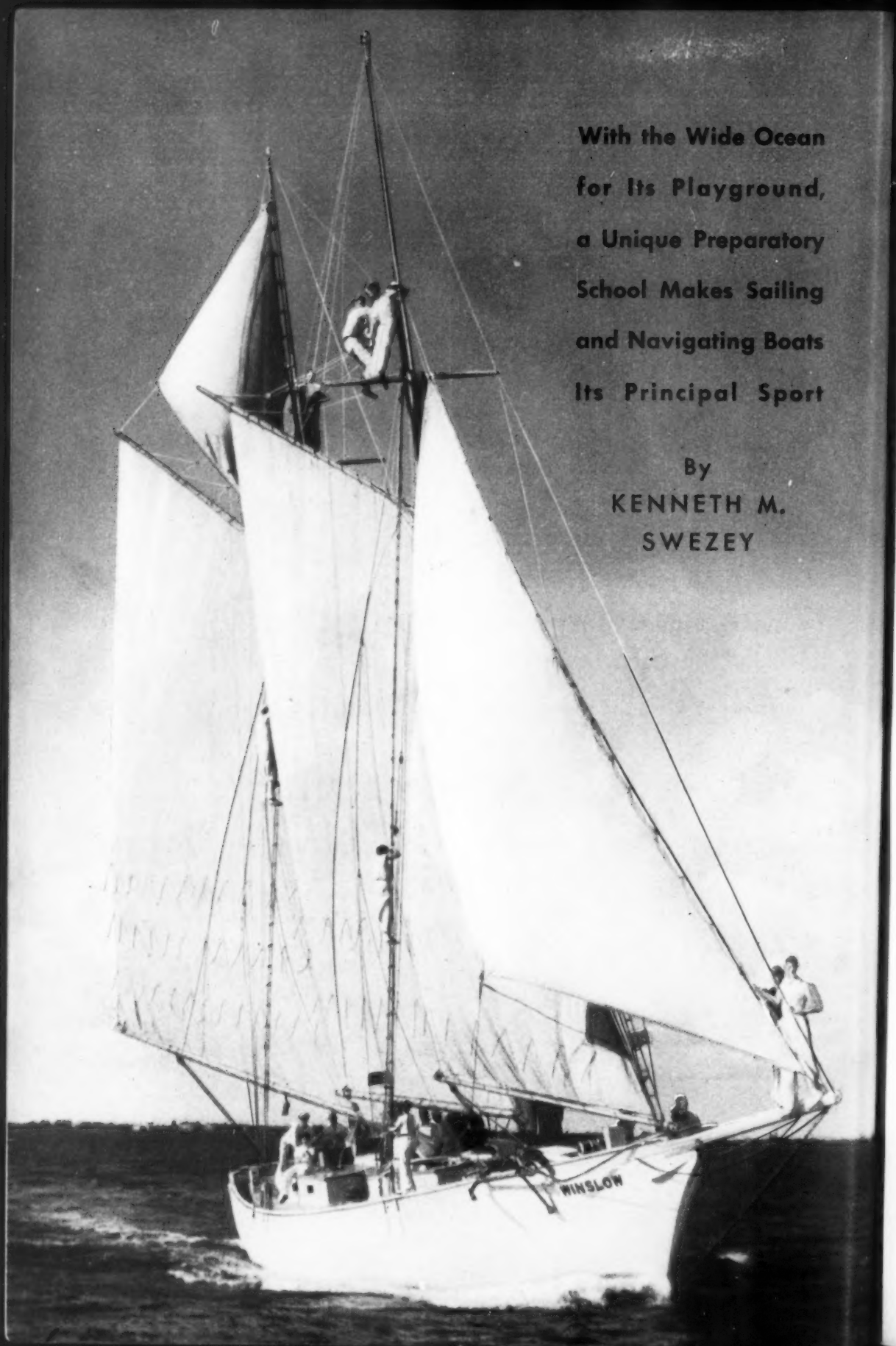
Clipped to a golf-club shank, the net is handy for lifting balls out of water hazards, as shown above

Exerciser for Dogs Is Chocolate-Flavored



This chocolate-flavored exerciser appeals to a dog's good taste

MADE of rubber, a durable exercising strap for dogs has no metal parts that can injure a dog's teeth, mouth, or gums as he chews and tugs on it. To encourage the animal to play with it, both ends of the strap are impregnated with a strong chocolate scent. A solid-rubber guard in the center of the exerciser protects the hands of the owner as he holds one end while the dog tugs on the other, as shown at the left.

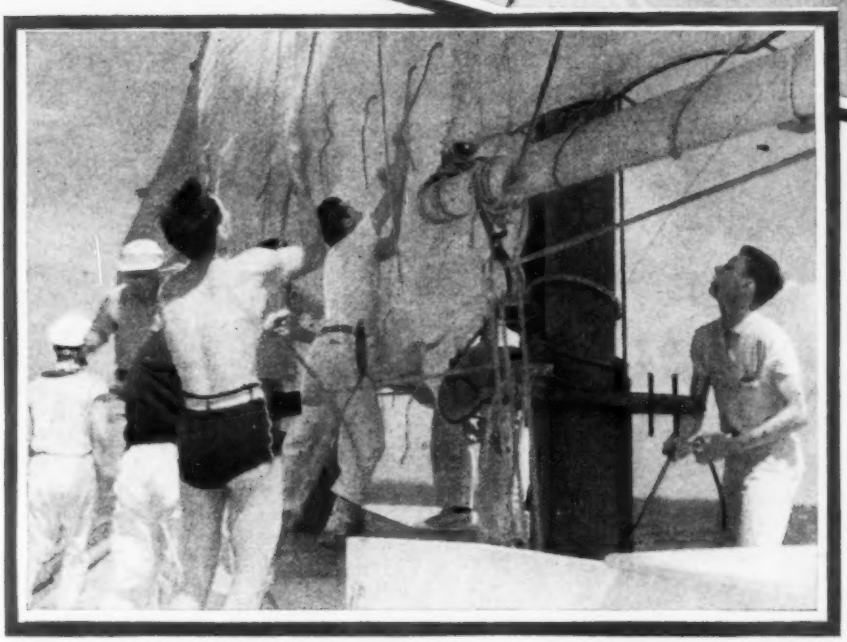


With the Wide Ocean for Its Playground, a Unique Preparatory School Makes Sailing and Navigating Boats Its Principal Sport

By
KENNETH M. SWEZEY

Harpooning a whip ray from the bow of a small boat off the Florida Keys

Students using their trigonometry to plot a course on a week-end cruise aboard the schoolship "Winslow"



The boys man and command the sixty-five-foot schooner at sea. At left they are reefing the mainsail

Schoolboys of the Sea

RACING across Biscayne Bay, at Miami, Fla., in a fleet of Moth-class sailboats, dingies, and Cape Cod knockabouts, and scudding over to the Bahamas in a swift sixty-five-foot schooner, is not only recreation but serious business to the students of a unique "prep" school that migrates to the North Woods in the spring and fall, and to Florida in the winter.

In this Adirondack-Florida school, sailing and navigating a boat form a definite and thrilling part of the program. The training is used not only to foster alertness and build strong muscles, but to help teach physics and mathematics. And, as an extra-curricular activity, sailing has been developed into a major sport, ranking with the football or basketball of more conventional schools and colleges!

Within the last few years, small-boat sailing and racing, as an athletic and recreational activity, has been taking hold rapidly in American colleges. An indication of how the sport is spreading is shown by the entry list

Aboard the "Winslow," a boy helmsman watches as his shipmates execute a difficult sail maneuver

Aloft on the ratlines. Climbing the sixty-foot masts is excellent training for nerve and muscle. At right, students are observing marine life on the bottom, in shallow water, by the aid of a glass-bottomed bucket

in the Boston Dingy Club regatta, held last fall on the waters of Charles River Basin, with the coöperation of the Massachusetts Institute of Technology. More than 1,500 undergraduates, from twenty-seven colleges throughout the country, participated. In a similar regatta, held in the spring of 1936, only nine colleges were entered.

In the Adirondack-Florida school, however, sailing is carried farther than mere incidental recreation. It was introduced thirty-five years ago by Paul C. Ransom, the founder, as an ideal mental and physical training that would get into the veins of the students and stick through the rest of their lives.

Right at the beginning, a big sailing vessel, as well as a fleet of small boats, was considered necessary. To put callouses on hands, and muscles on chests and arms, sixty-foot masts had to be climbed, large sails hoisted, and 200-pound anchors fished and catted. Only a large boat could furnish, under all weather conditions, the necessary exercise for muscle tone. And only on deep-sea cruises could the boys really learn navigation.

The present flagship of the school, the sixty-five-foot schooner *Winslow,* was built to order, just two years ago, as an embodiment of all the knowledge of design gained from experience with earlier vessels. On it the students take cruises among the Florida Keys and to the Bahamas, every good week-end during the winter term.

Although they are under the constant guidance of Capt. Ernest Schwarz, an old sailing master who in boyhood sailed on American clipper ships, the boys command and man the entire ship. On some of these cruises they go deep-sea fishing, or harpooning for whip rays and sawfish. The ship carries several diving outfits, and often the students go down in these to explore the amazing marine life on the bottom of the ocean.

Instead of the usual football eleven and

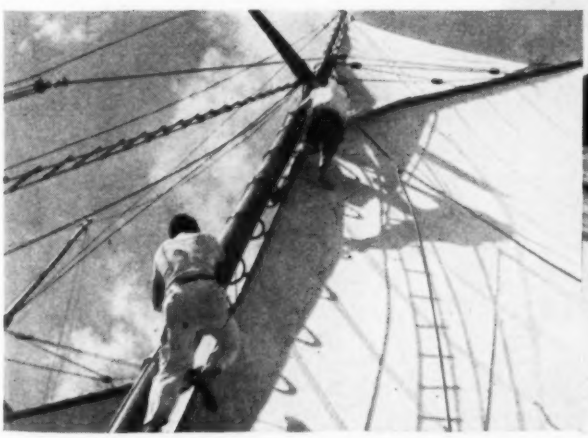
baseball nine, with their captains and managers, the school has its yacht club, with its commodore, vice and rear commodores, and fleet captains. Members are rated, according to ability, as common seamen, able seamen, midshipmen, and ensigns. Ensigns must be able not only to handle a pelorus, read a weather map, name cloud types, and work a traverse course at sea, but also to calculate latitude and longitude by shooting the sun with a sextant.

Between week-end cruises in the *Winslow*, the small-boat fleet goes into action. Intramural racing is done after school hours in the natty little Moth-class boats. One of the yacht-club officers oversees the starts, while another polices the course. Two motor launches stand by for emergency rescues. Although the northern home of the school is high in the Adirondack Mountains, plans are already under way to establish another fleet there, on Rainbow Lake.

One of the predecessors of the schoolship *Winslow* was a ninety foot reproduction of Columbus's caravel *Santa Maria*, luxuriously fitted with electric lights, a fully equipped kitchen, and oak-paneled dining room.

Started to help create a permanent hobby for the students, and to instill in them a lasting love for the outdoors, the sailing activities of the school have been conspicuously successful. Graduates already include many world travelers, yachtsmen, explorers, and nature writers.

Capt. Ernest Schwarz, who, as a boy, sailed on the clipper ships, showing a youthful mariner how to "shoot the sun" with a sextant



Diving suits make it possible for the students to explore the ocean floor. Here a boy is going over the side for a little laboratory work in marine biology. Left, higher education in the ship's rigging

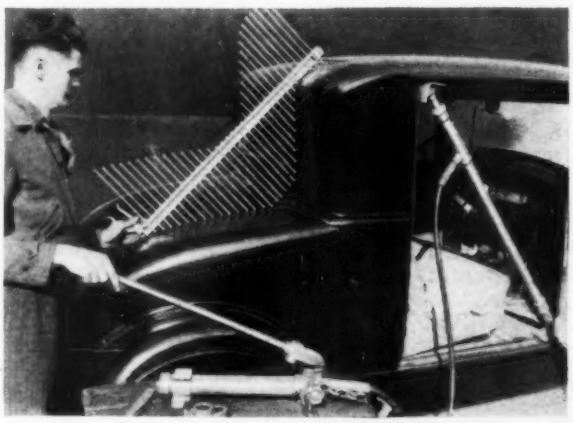
Pilot Assen Jordanoff taking the temperature of "frozen gasoline" in his fuel tank

Motor Fuel Is Chilled for Safety

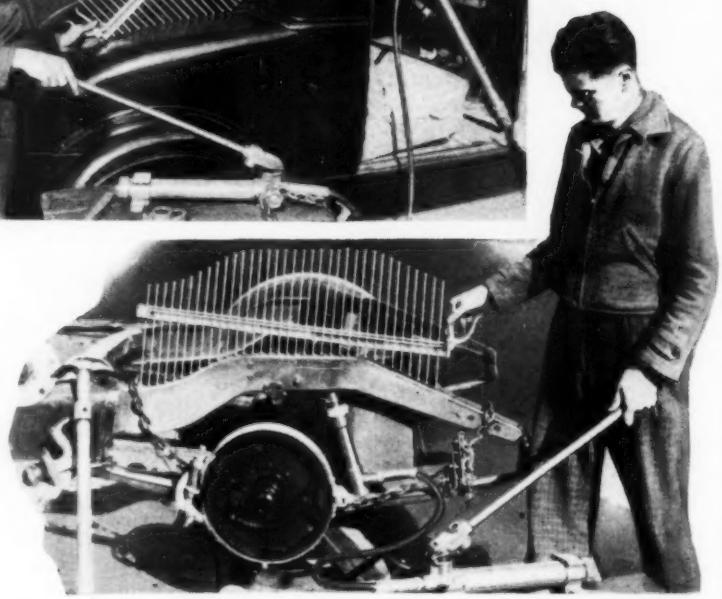
TO REDUCE the fire hazard in airplanes, Assen Jordanoff, New York transport pilot and aeronautical engineer, has developed a method of cooling gasoline in plane tanks to make it practically noninflammable. His equipment employs dry ice and alcohol to lower the gasoline to a temperature of 148 degrees below zero, F. The fuel is heated to normal temperature as it enters the engine.

"Feelers" on Template Measure Contours

CONTOURS can be measured quickly and accurately with a novel adjustable template recently placed on the market. Used as a precision tool in construction and repair work on automobile bodies, boats, airplanes, and in welding, pattern, and die shops, the unit consists of thirty-five slender metal rods that slide vertically through holes in a horizontal frame. When the instrument is placed over the surface of a part, the metal rods automatically drop down into a position where they form an outline or contour of the surface. A grip on one end of the template is then squeezed to operate a locking mechanism that holds the feeler rods firmly in position. The photographs at the right show the unit being used with a hydraulic jack to correct contours of body and frame.



Rods slide down through the template frame and are locked into place to measure a desired contour



The new template in use for correcting the contour of a bent chassis frame

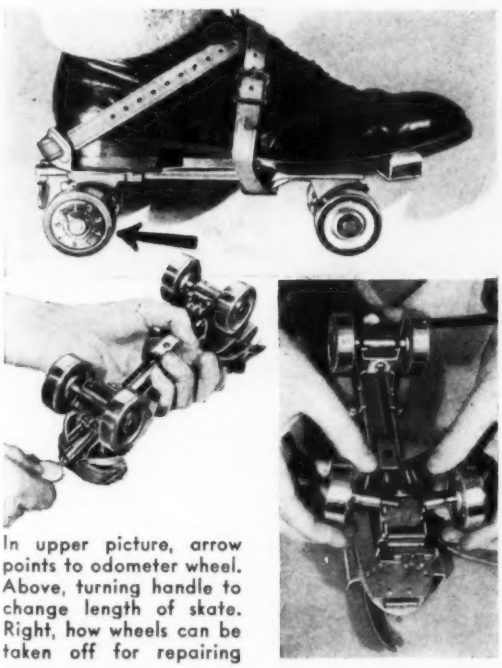
When the toy is launched in the air, the small plane releases itself

Glider Toy Copies Pickaback Plane

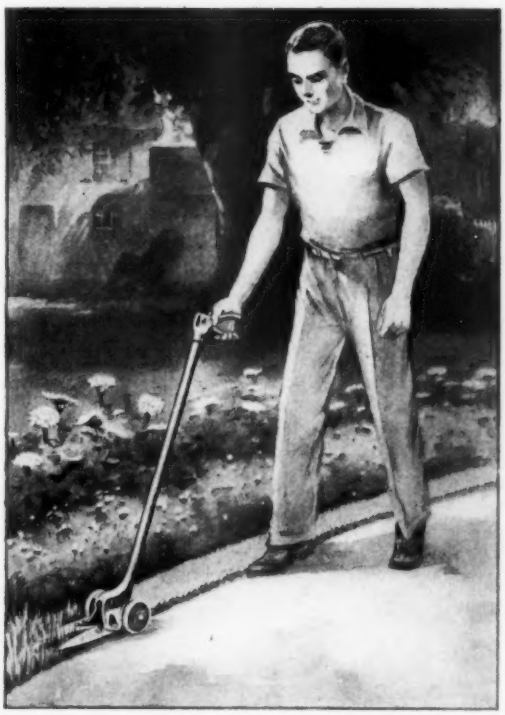
SIXTEEN inches long, a toy pickaback plane now on the market is modeled after the composite twin airplane first developed in England (P.S.M., Jan. '35, p. 41). When the craft is launched by throwing it with the aid of a stick, the smaller plane, mounted on the back of the larger, automatically releases itself and goes into an inside loop while the mother ship glides on to a landing. Both planes are made of balsa wood and either may be flown separately.

Skate Registers Mileage

SKATING DISTANCE in miles is automatically registered on an odometer built into a rear wheel of a roller skate now available. Said to support a 300-pound man, the skate has an extension screw that changes its length when a folding handle at the back of the skate is turned. Toe clamps are easily adjustable by means of movable clamp rivets that fit into holes spaced at intervals. Crossed leather straps permit free ankle movement, and wheels are easily removed.



In upper picture, arrow points to odometer wheel. Above, turning handle to change length of skate. Right, how wheels can be taken off for repairing



Grass Shears on Wheels

TRIMMING grass along sidewalks or paths, under hedges, and around shrubbery is made easy with a novel pair of shears fitted with a thirty-two-inch handle and small wheels that make it resemble a miniature lawn mower. Squeezing the grip at the top of the handle operates the blades as they are pushed along the ground.

Slot-Machine Insurance

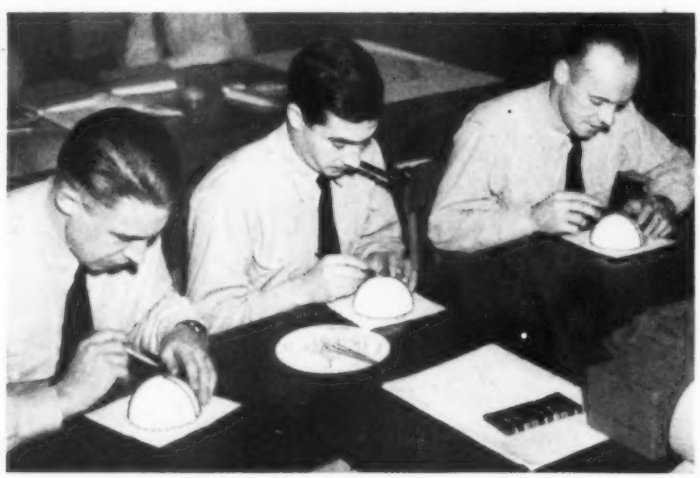
INSURANCE is now sold like chewing gum. Drop a quarter in a new slot machine, write your name and the name of a beneficiary in the space provided, turn a crank, and out comes an accident insurance policy for $7,500, good for twenty-four hours. Above, a customer is signing on the dotted line.

Light Shines, Bell Rings When Car Is Backed

ATTACHED to the rear bumper of a car, a new automobile accessory that combines a bell and a light helps prevent accidents in backing. Operated by a dashboard switch placed close to the gearshift lever's backing position, the unit throws a strong light behind the car to aid the driver's rearward vision while ringing the built-in bell to warn persons in the way. Details of the accessory are pictured in the inset below.

Controlled by a dashboard switch, this car accessory reduces danger in backing

Pilots Study Navigation on Tiny Globes



Students of aerial navigation working out problems on white hemispheres

IN ONE of the courses given to U. S. Army aviation students at the 9th Bombardment Group navigation school, Mitchel Field, Long Island, N. Y., budding pilots and navigators solve triangulation, direction-finding, and locating problems with the aid of small white hemispheres on which they can plot out their work in pencil. Using the white half globes, the students are better able to visualize latitude, longitude, great-circle routes, and other factors of aeronautical navigation puzzling to beginners. The photograph shows three of the students at work.

Fish purchases can be carried home in bags like this

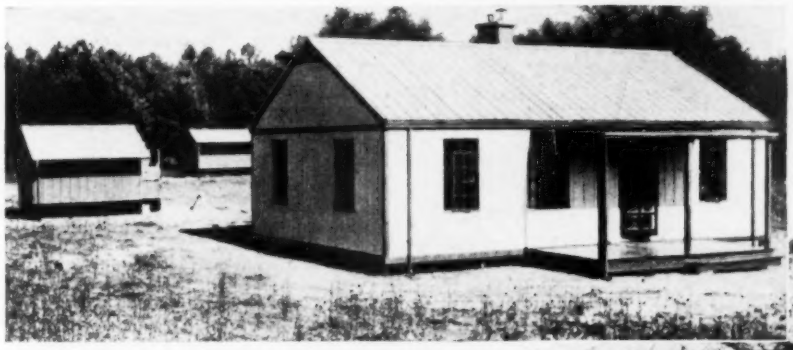
Pet Shops Wrap Fish in Transparent Bags

CUSTOMERS of pet shops selling goldfish and various tropical species can watch their purchases swim around as they are carried to home aquariums in novel transparent bags just introduced. Made of waterproof, transparent cellulose material, in various sizes, the fish bags have reënforced handles for ease in carrying. When the container has been partially filled with water, the fish are transferred to it from the store tank.

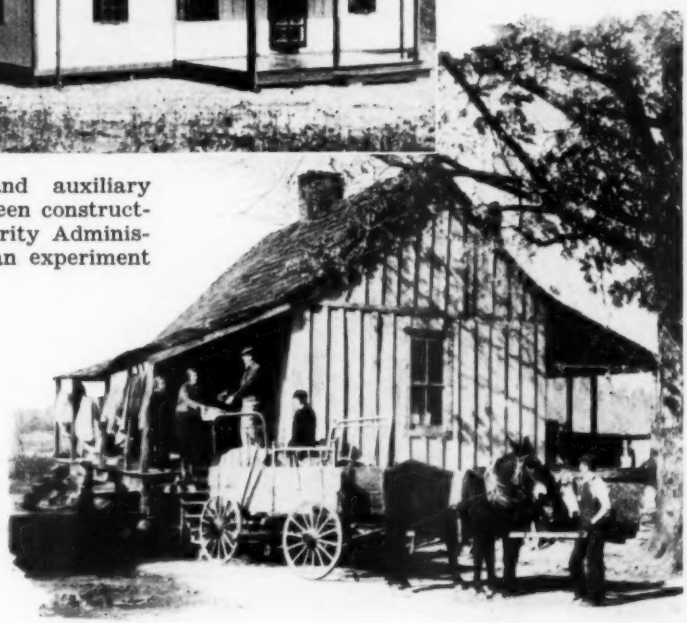
Drug Stimulates Plants

SULFANILAMIDE, the wonder drug that is medicine's newest and most sensational weapon against many types of deadly disease (P.S.M., Mar. '39, p. 63), appears in a new rôle in a report by Dr. N. H. Grace, Canadian scientist. Applied in dilute solutions, the chemical has been found to speed up the growth of plants.

Farmhouses and Barns Are Made of Steel

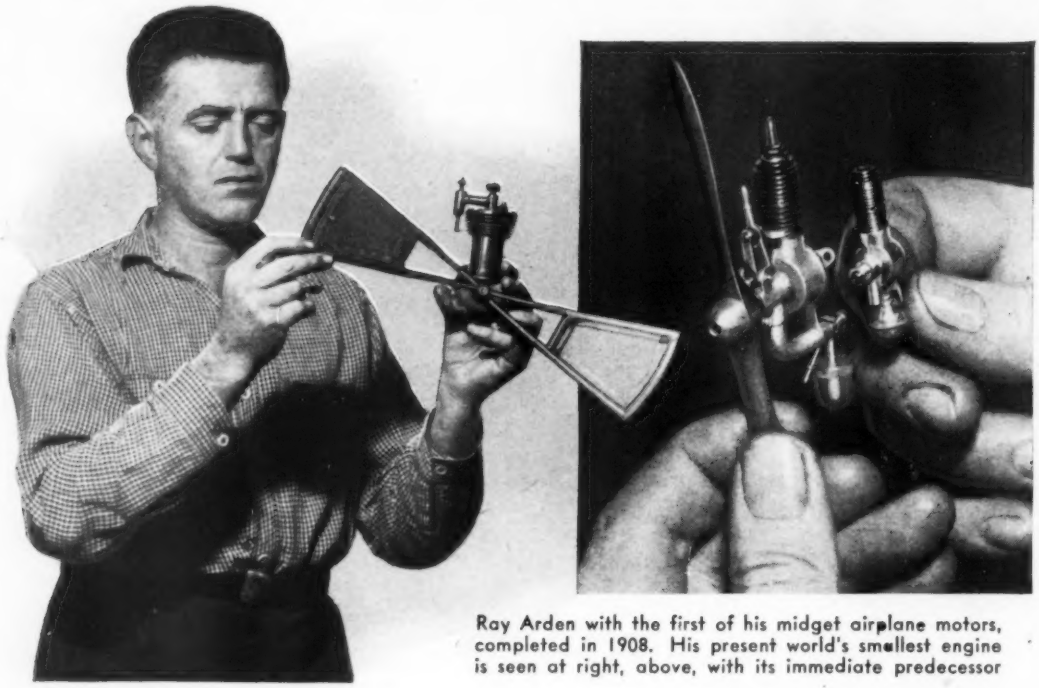


All-steel farmhouse and outbuildings near Jasper, Ala. The picture below shows the shack from which tenants moved into the experimental structure



ALL-STEEL farmhouses and auxiliary buildings have recently been constructed for the Federal Farm Security Administration near Jasper, Ala., as an experiment in low-cost farm housing. All buildings in the experimental homestead pictured above are made of steel, set on steel piers sunk into the ground. The dwelling has a living room, three bedrooms, combination dining room and kitchen, porch, insulated walls, and a special fireplace that doubles as a furnace in winter. Outbuildings include a barn, smokehouse, poultry house, and privy.

He Builds the WORLD'S

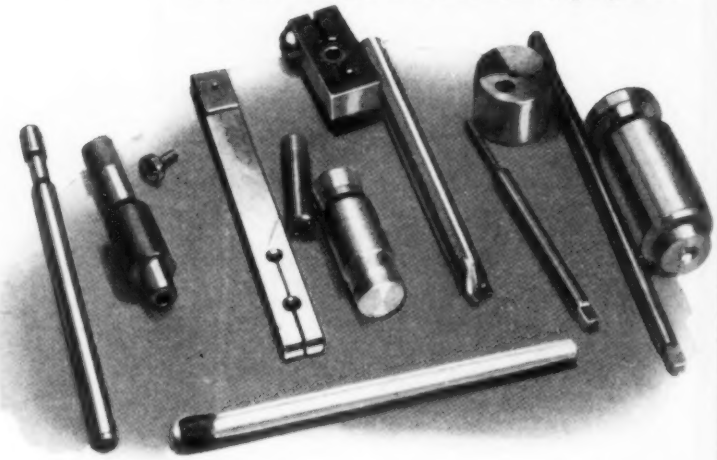


Ray Arden with the first of his midget airplane motors, completed in 1908. His present world's smallest engine is seen at right, above, with its immediate predecessor

IMAGINE a motor so tiny it spins 18,000 times on a single drop of gasoline! Imagine a spark plug so minute it is hardly larger than the head of a safety match, yet so perfect it will fire 300 times a second! Imagine a carefully designed power plant, complete in every detail, that weighs less than a .22 caliber cartridge!

That world's smallest gasoline motor has just been completed in the workshop of a Baldwin, N. Y., inventor. Among the towering structures, the rainbow colors, the thrilling pageantry of the New York World's Fair, it will form an exhibit spectacular because of its littleness. The story of this tiny power plant and of the thirty-year ambition which led to its creation, is the story of an extraordinary inventor—Ray Arden, creator of Lilliputian machines.

Ever since he was in kindergarten, Arden has been inventing things. One day, when he was only five years old, his grandfather, who had noticed his mechanical precocity, brought him two ailing timepieces. He had wagered a friend that the child could fix a broken clock. As an incentive, he promised to give the boy the second timepiece if he repaired the first. As soon as young Arden had won his reward, he used the clockwork mechanism to propel his



Special tools used in making the pygmy engine, compared with a match

SMALLEST MOTORS

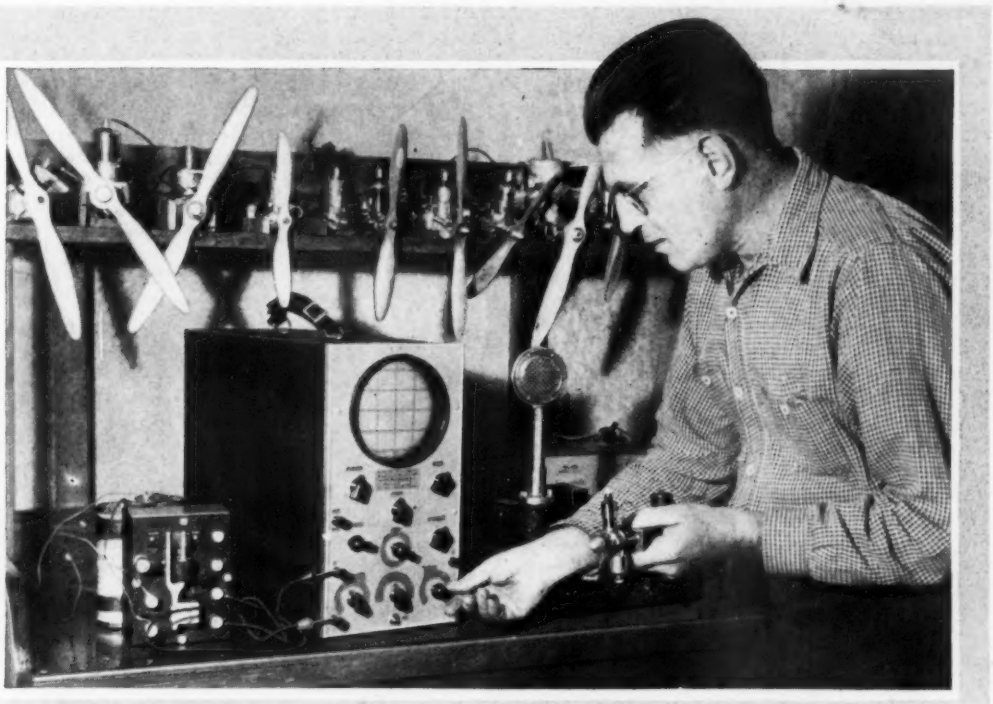
first invention, a toy automobile with two speeds, one for level ground, the other for inclines. By slipping the clockwork motor into place so that either a large or a small cogwheel engaged the ground, the kindergarten inventor could make his toy go fast or slow, as he desired.

By the time he was eleven, he was riding around in a homemade steam automobile. A relative had died and left the boy a half-horsepower steam engine which had been used to run a lathe in a back-yard machine shop. Automobiles were still a novelty in 1904 when young Arden steered his cracker-box limousine around the block with a long trail of shouting boys racing behind. A New York City newspaper ran a special article on the event with a picture of the youthful inventor seated in his "road locomotive."

About this time, he acquired a huge steam whistle which had seen service on a launch. With this mounted on his steam car, he pulled up in front of his home and let off an ear-piercing blast that rattled windows on both sides of the street. When heads popped from doors and windows to see what was going on, he opened the throttle and prepared to get under way in a blaze of glory. But the machine refused to budge. That one toot of the whistle had used up all the steam in the boiler!

The following winter, something occurred that made him neglect his steam machine and devote himself to the work that has made him famous. A neighbor took him to see a sportsman's show at the old Madison Square Garden. Before one of the booths, the boy remained rooted all afternoon. Supper time came and went. At eleven o'clock at night, when the show closed, he was one of the last to leave. The exhibit that had held him fascinated was a six-foot model biplane

By John E. Lodge



Here Arden is using a cathode-ray oscillograph to measure the efficiency of one of his power plants. Such tests have shown that his latest product, which weighs only an eighth of an ounce, is more efficient, for each cubic inch of cylinder space, than the best modern two-cycle motor-boat engines!

In addition to building midget motors, Arden has taken out more than 400 patents on inventions of many kinds. Here he is demonstrating his range-finding telescopic rifle sight, said to be a great improvement in its field

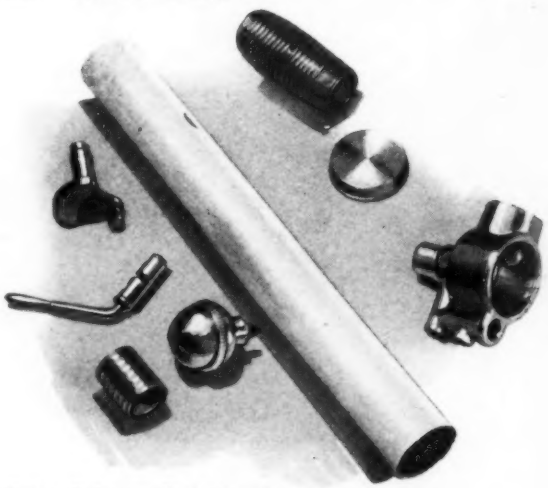
equipped with a crude single-cylinder gasoline engine weighing only two pounds. Both were the handiwork of A. M. Herring, an engineer who had worked with Octave Chanute during the latter's pioneer gliding experiments in 1895. The model had been placed in the booth to attract attention to a motorboat engine that Herring had on display.

But Arden hardly saw the marine motor. Day after day, as long as the show lasted, he returned to gaze on the tiny motor and the flying machine. He determined to build the smallest aerial motor in the world. For thirty years and more, he has been spending odd hours working toward his goal. Year after year, he has seen his little engines better former marks until, today, his World's Fair exhibit has broken all records for miniature aerial power plants.

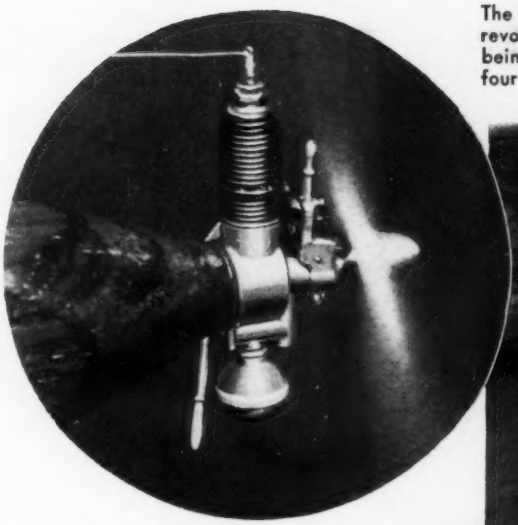
During the winter of 1907-8, young Arden rushed home from school every day and buried himself in his basement workshop. Without any previous training and with only relatively crude tools to help him, he built a motor half the weight of Herring's. This four-cycle, single-cylinder engine spun, at 3,000 revolutions a minute, a primitive propeller fashioned of steel rods covered with oiled silk. Arden still has this first of his long line of midget engines. Even today, more than thirty years after it was built, it runs as well as ever. In the summer of 1908, this Adam of the Arden motors pushed a model biplane, with a wing spread of six and a half feet, into the air on a long flight across a race track on the northern edge of New York City.

The machine with its one-pound motor was exhibited at one of the first aeronautical shows ever held in New York. Alexander Graham Bell, inventor of the telephone, was greatly interested in young Arden and his work. After the show was over, he gave the boy a number of the cells from his famous tetrahedral kite for experimental purposes.

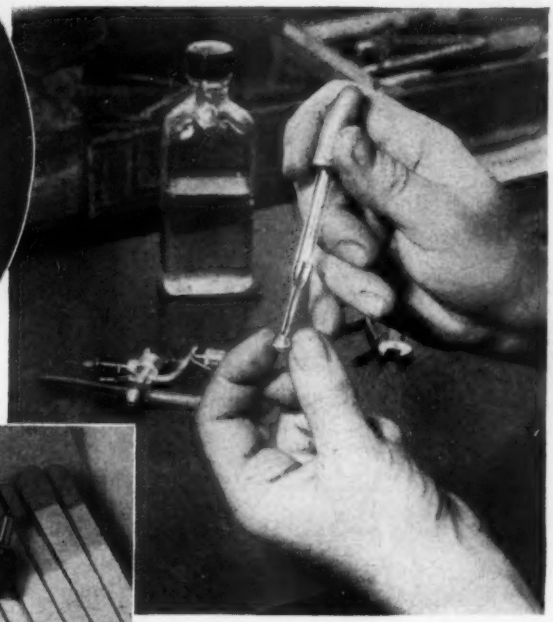
Another innovation of Arden's, not long afterwards, attracted the attention of additional pioneers in aerial navigation. At the time, the best spark coil weighed three quarters of a pound and gave a spark half an inch long. Characteristically, Arden decided to make a smaller coil. He succeeded in producing one that cut the weight by a third and yet gave a spark half again as long. Glenn Curtiss was one of his first customers, and the coil was used on the motor of a propeller-driven wind wagon built by Curtiss years before he rose from the ground in his first crude biplane.



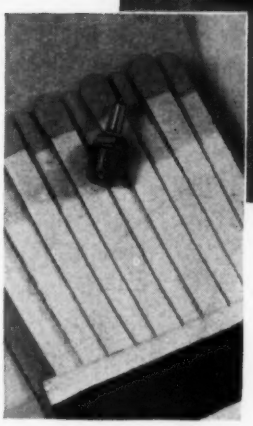
Parts of the smallest aircraft engine, compared with a cigarette. Assembled, it can be carried in a spectacle case



The motor in operation, spinning a propeller 18,000 revolutions a minute. Below, a medicine dropper is being used to fill the fuel tank, which holds just four drops of a special mixture of gasoline and oil



Since producing that smaller coil, Arden has developed a long string of midget innovations, almost all of them advances in the direction of compactness, lightness, and reduced size. All told, he has taken out more than 400 patents. They cover everything from toys and electric-clock improvements to gun sights and surgical instruments. For years, Arden has been recognized as one of the ace toy inventors of the country. Several new trends in playthings have come from his Baldwin workshop. Once, a manufacturer paid him $1,000 for a week's work. During that time, Arden redesigned a faulty toy that had been advertised and then found defective in design.



Here the diminutive spark plug is dwarfed by a book of matches

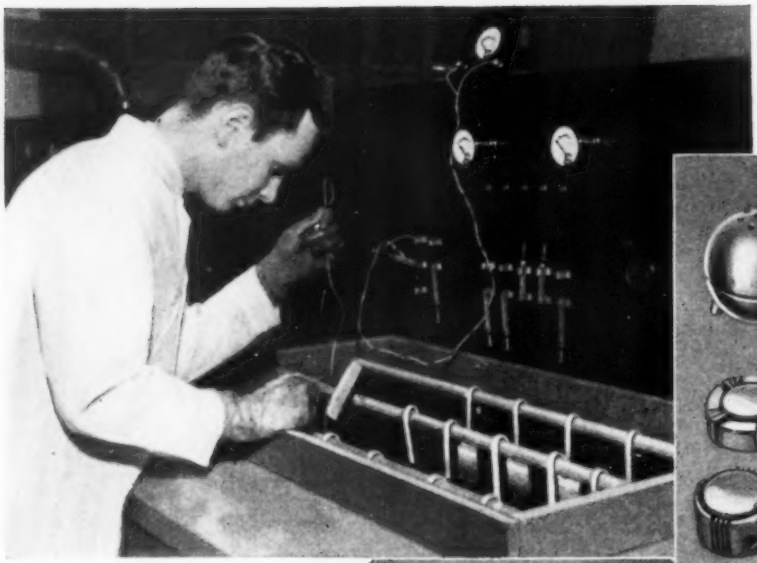
But, all through these years while he was bringing out profitable innovations, Arden was devoting his spare time to building smaller and smaller engines. By 1910, he had produced a two-cylinder midget which weighed only fourteen ounces. In the quarter of a century that followed, Arden whittled off more than twelve additional ounces. In 1936, his two-ounce motor, humming like an angry bee, spun a ten-inch propeller at 12,000 revolutions a minute. Based on a new principle, the single-cylinder, two-cycle power plant has a bore and stroke of only half an inch. One of America's leading toy manufacturers is planning to put a refined model of this motor on the market in the near future.

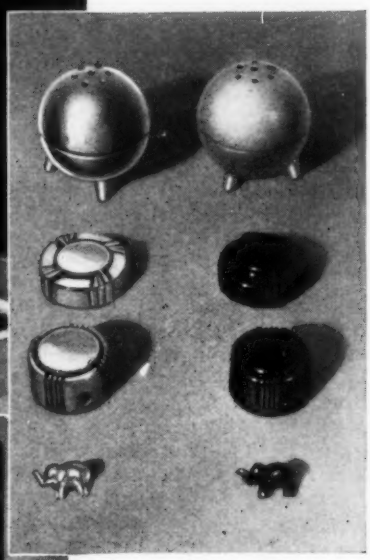
Last year, just thirty years after he completed his first miniature power plant, Arden passed a goal of long standing, producing a motor that weighed less than an ounce. It has a bore and stroke of only five sixteenths of an inch and spins its propeller at 15,000 revolutions a minute. Complete with the propeller, the Tom Thumb motor weighs but 215 grains, approximately three eighths of an ounce.

Work on his World's Fair Lilliputian engine, which slices this weight to one third, or only an eighth of an ounce, commenced early last autumn. It was finished about the first of the year. The pygmy spark plug alone took Arden 100 hours to make. It weighs, completely assembled, only four and a half grains. Platinum-iridium forms the electrodes, with fused quartz for the insulating material and heat-treated alloy steel for the base of the plug. So delicate was the work of turning out these parts that diamond-pointed tools were used for the cutting, with fine copper wire and diamond dust employed for drilling through the quartz.

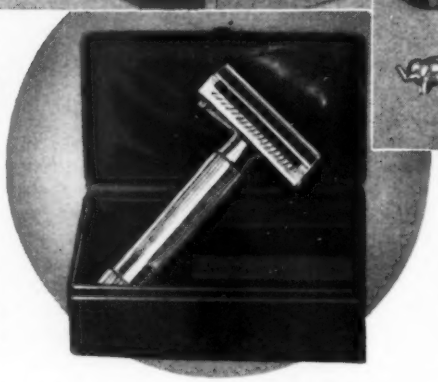
Arden has reduced the weight so nearly to the minimum on his little engines that, in spite of infinite care, he was able to save only 1/8,000 of a pound in turning out this latest spark plug. Before he could begin work on the engine, he had to make a special kit of midget tools—taps, dies, drills, and laps no longer than a kitchen match. The work is *(Continued on page 240)*

Home Chemist Creates an Industry





Bernard F. Walker in his laboratory. Below, some common plastic articles, with and without their coats of metal applied



This safety razor, made of plastic with a silver plating, is lighter than a metal one

PLASTIC materials of all kinds can now be plated with thin coatings of gold, silver, and other metals as the result of a new chemical process worked out by Bernard F. Walker, a young inventor whose inspiration for the idea came while he was experimenting in a modest home-chemistry laboratory. Leaving high school at Far Rockaway, N. Y., a few years ago, Walker went to France with his father, a European representative for American business firms. While studying in Paris, young Walker became interested in chemistry, set up a small laboratory in his home, and began experimenting with metal plating on glass. Knowing that a French manufacturer had been anxious to develop a process of plating plastics with metal, Walker's father suggested that he switch to this problem. In less than two years, the young chemist had the solution.

The secret lies in a bonding coat consisting of two chemical substances which are applied to the plastic separately by a tumbling or agitation process. This gives the plastic piece a smoky gray surface which has a natural affinity for metal when immersed in an electroplating bath. The metal coating can be applied in any thickness up to 1/100 of an inch, and, according to the inventor, it will not peel off and can be removed only by scraping with a sharp instrument.

One illustration of the thousands of possible uses for the new process is demonstrated by a plastic safety-razor unit, pictured above, that is coated with a thin plating of silver. Although the razor has the appearance of regular metal types, it is very much lighter in weight.

Since the plastic part being plated may be masked, to allow the coat of metal to adhere only to exposed portions, intricate designs simulating inlays may be laid on either molded or laminated plastic materials. Brand names can be plated on plastic containers, and monograms on boxes designed for various purposes. Elaborate designs in metal can be applied to buttons, combs, cosmetic containers, pencils, pens, and practically any number of other popular items.

From an idea in a home chemistry lab, Walker has seen his plating process grow by leaps and bounds into a thriving and important young industry.

Hydraulic pressure raises the stewards' stand at start of race

Hydraulic Elevator Raises Tower for Race-Track Officials

RISING from ground level on a hydraulically operated steel shaft like a garage oiling rack, the stewards' booth at a California race track is elevated to a height of twenty feet before the start of each race. Between events, the official observation booth is lowered to the ground to allow spectators a clear view of the mechanical board that lists betting odds.

Cuticle "Pen" Aids Manicure

When the button is pressed, cuticle solvent squirts onto the finger nail

CARE of the finger nails is simplified by a novel manicure accessory resembling a fountain pen. When a button on the side of the device is pressed, a small amount of liquid is squirted around the cuticle, the dead skin around the base of the nail, to dissolve it. This loosened skin is then scraped off with the point of the pen, resembling an ordinary cuticle stick.

Bottle Refrigerator Holds Beverages

A NOVEL beverage refrigerator that also serves as a display and dispensing cabinet for stores is made in the form of an eight-foot-high bottle. To attract attention, the refrigerator door is outlined with a green neon-type tube and fitted with a glass window so that customers can see bottles arranged on seven inside shelves that may be revolved.

Jumbo Candid

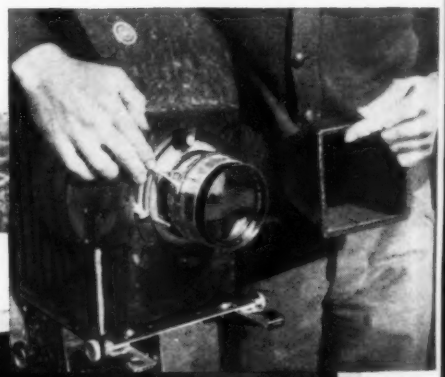
TAKES FAST-ACTION

By
Andrew R. Boone

•

Gordon Head sights his big camera to make a fast-action shot. It has candid-camera flexibility, yet it takes large pictures

Below, Head sets the diaphragm. It stays wide open for focusing, then "stops down" when shutter is tripped



This movie-set storm striking a ship was caught at 1/1,200 second

Camera

PORTRAITS

COMBINING the qualities of speed cameras with those of a portrait instrument, a new lightweight camera has been devised by Gordon Head, Hollywood photographer, for snapping portraits and picturing fast action on moving-picture sets without taking his eyes from the scene.

Called an "action-portrait camera," the big box makes unnecessary the flowing black cloth ordinarily used by portrait men. Head makes all preliminary adjustments to lens and shutter, inserts an eight by ten-inch plate, and removes the slide. He then peers through a special finder at a ground glass that shows the image entering the lens. Thus, the photographer sees exactly what he will get on the plate, while the plate is in position for instant exposure. While he focuses the camera, the lens remains wide open. Then, when he snaps the shutter, an arm connected with the shutter automatically sets the iris diaphragm to a predetermined stop.

Mounted on a special tripod, it is as easy to aim and focus as a miniature

Head built the camera, which weighs twenty-five pounds, of duralumin. It can be operated at shutter speeds varying from four seconds to 1/2,000 of a second. It may be "panned," or turned on its tripod, like a moving-picture camera, permitting the operator to follow the action. The camera is equipped with a back which may be tilted and swung sideways, thus bringing both near and distant objects into the same apparent plane, which heightens the degree of sharpness on all parts of the plate. The plate holder may be revolved without being removed, a series of steplike light traps keeping all light from the camera's interior. Finally, each leg of the special tripod is locked by means of a single clamp, instead of the customary two.

With this camera, it is possible for the first time to take large-size, action pictures with the same convenience afforded by the small candid camera; and the pictures have the same high quality as a carefully composed portrait.

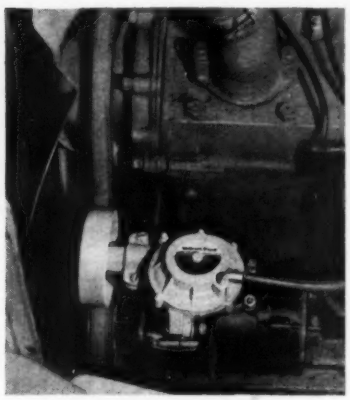
The back may be both tilted and turned while the lens remains stationary, to bring all parts of a picture into the same plane

Book Becomes Toy Circus Tent

A PICTURE BOOK of zoo animals that changes into a revolving toy circus tent is a children's novelty just placed on the market. When the story about the various animals and how they are captured has been read, the book's page ends are folded and mounted so that the resulting circus tent revolves on a wooden pedestal.

Vacuum Pump Runs Windshield Wiper

WINDSHIELD wipers operate at constant speed even when a car is laboring uphill or accelerating rapidly, when a new vacuum pump is installed. A special check valve opens a line from the wiper to the source of vacuum that is greatest at the time—either the intake manifold or the pump, driven by the fan belt.



Fabric-Covered Piano Matches Furnishings

PIANOS that match wall paper, curtains, or draperies of the rooms in which they are placed, strike a new note in interior decoration for homes. As shown in the photograph at the right, the piano, except for the keyboard unit, is covered with a figured fabric which in this case matches the draperies hanging at either side of the instrument. If the owner of the piano tires of the cover fabric, or plans to change the decorating scheme of the room, he can have the instrument re-covered with a different fabric to match the new materials.

Piano is covered with fabric to match wall paper or curtains

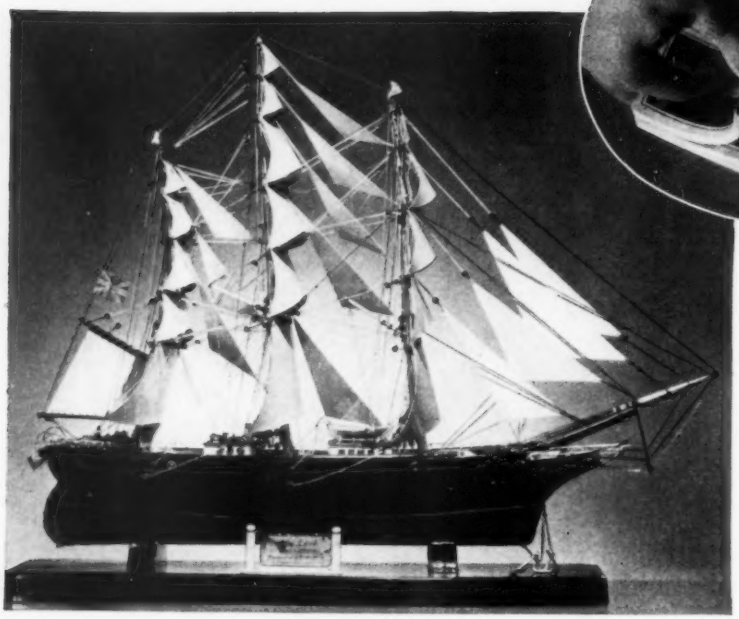
SHORT-WAVE TRANSMITTER IN AIRLINER BROADCASTS CONTINUOUS SIGNAL WHILE PLANE IS IN AIR
How Two Stations Find Position of Plane
STATION No. 1
ANGLES SHOWN BY DIRECTION FINDERS
BASE LINE
PLANE ON COURSE
PLANE OFF COURSE
STATION No. 2
MEASURED DISTANCE BETWEEN STATIONS FORMS BASE LINE FOR PLOTTING POSITION OF PLANE
DOUBLE-LOOP AERIALS AUTOMATICALLY FOLLOW PLANE, AS SHOWN BY ARROWS
Altitude Finder
Direction Finder
AUTOMATIC RECORDERS CONSTANTLY REGISTER DIRECTION AND ALTITUDE OF PLANE
RECEIVER
BATTERIES
GENERATOR
MOTOR KEEPS AERIAL TRAINED ON PLANE
Station No. 1

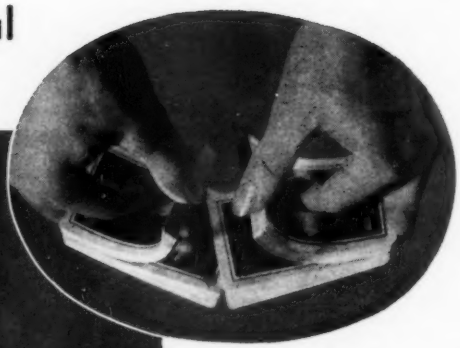
Radio Traces Plane's Flight

ERECTED in pairs at fifty-mile intervals along a major airway, automatic radio direction-finder stations would follow a plane's flight from beginning to end, in a system proposed by a California inventor to speed aid in case of forced landings. At each station, two aerials receive continuous signals from a wind-powered transmitter in the plane. One aerial, the "direction finder," automatically rotates on a vertical axis to equalize the strength of signals picked up by its right-angle loops. Its movement, graphed on a revolving drum, shows the compass bearing of the plane from the station at all times. The other aerial, the "altitude finder," rotates similarly on a horizontal axis to show the elevation of the plane. Comparing the records of each pair of stations shows the position and altitude of the plane at any moment. In case of a crash, the loops remain pointing to the direction of the last signal.

MAY, 1939

New Flexible Plastic Material Used in Making Model



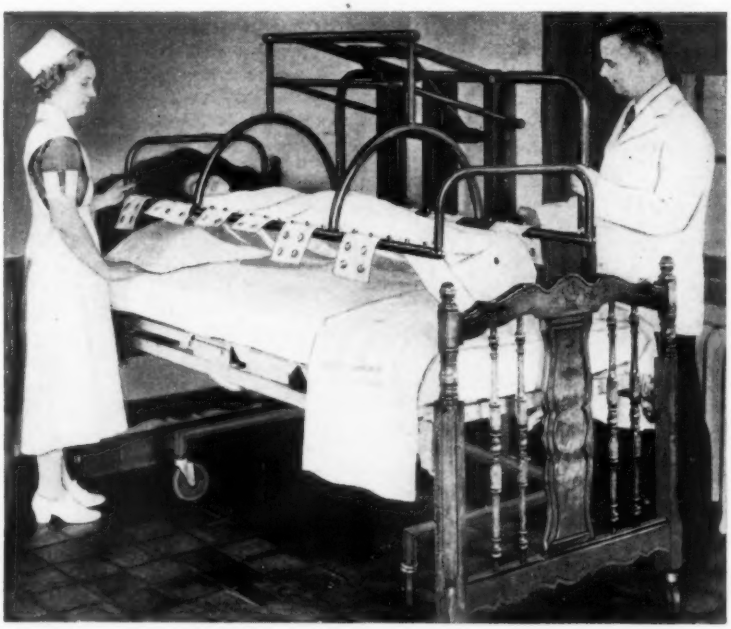


A material used in washable playing cards forms the trim clipper-ship model at left

COMMONLY used in decks of washable playing cards, a noninflammable cellulose plastic material forms not only the deck but also the hull, sails, and other parts of a clipper-ship model recently completed by Fred Harris, of Petros, Tenn. The unusual model, seen in the accompanying photograph, is an accurately scaled reproduction of the famous clipper ship *Cutty Sark*, in her time one of the fastest vessels afloat. Easily worked, the flexible plastic material is said to lend itself well to model making. It is easily cleaned with soap and water, and has great color stability.

Carrier Lifts Patient off Hospital Bed

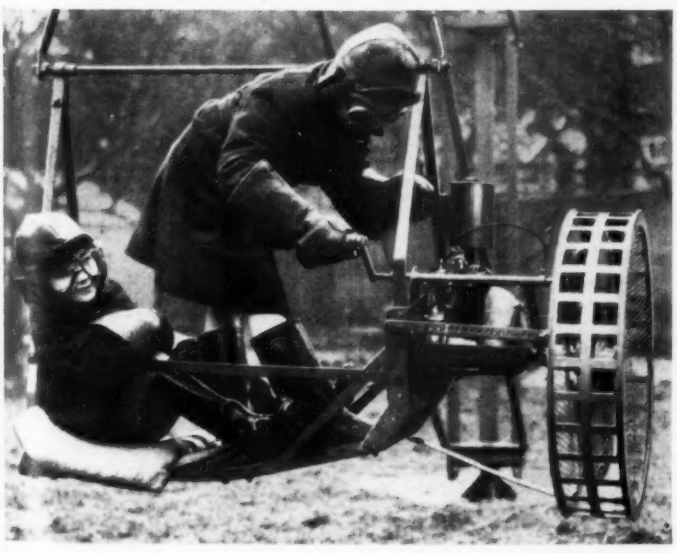
HOSPITAL patients are easily lifted from their beds and rolled to operating, X-ray, or special-treatment rooms in a novel invalid lift just introduced. Six canvas bands are inserted under the patient and their ends hooked to a tubular lifting framework mounted on a wheeled base. Turning a handle on the device operates a gear mechanism that raises the patient gently off the bed for wheeling to any part of the hospital.



When a crank is turned, canvas bands lift the patient gently off the bed

Christopher and Maureen Elliott enjoying a ride on their backyard merry-go-round

Propeller Drives Homemade Flying Merry-Go-Round

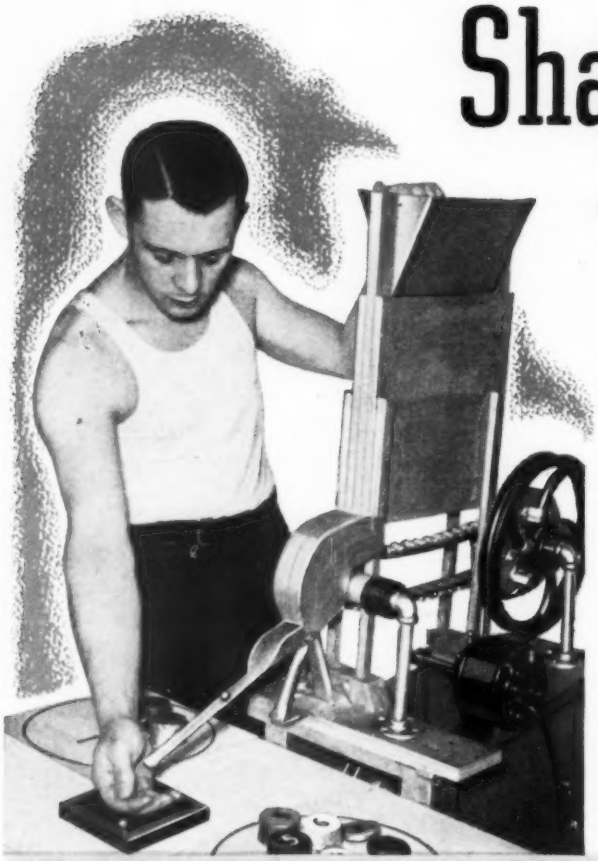


Contact! The young pilot spins the prop while his passenger looks on

A FLYING merry-go-round in their own back yard is the pride and joy of young Christopher Elliott and his sister Maureen, of Beccles, Suffolk, England. Built by their father, the novel whirligig has a two-passenger open gondola suspended from twin booms that revolve around a central post firmly set into concrete. Driving power for the unusual homemade flying machine is furnished by a one-horsepower gasoline engine that whirls a twenty-three-inch wooden propeller incased in a protective cowling of wire and metal. Cross bracing between booms and center post adds stability.

Shaking Dice

ODD TESTS SHOW EFFECTS



Subject times marble passing through the "chance machine"

TO FIND out what heat and humidity do to the human body, perspiring volunteers are playing with marbles and rolling dice in a cork-lined heat chamber at a Pittsburgh, Pa., laboratory. Living for hours at a time in a man-made inferno, these human guinea pigs try novel tests that may point the way to better health and comfort for thousands of workers.

A curious reason lies behind the experiments—the fact that high humidity is essential for handling thread and yarn successfully, in making cloth. Years ago, the textile industry began to flourish in Manchester, England, because of the dampness of the atmosphere. Later, for the same cause, it grew

Thermometer with skin-contact element for determining surface temperatures

The apparatus below measures the consumption of oxygen by the body in test

in a Man-Made Hell

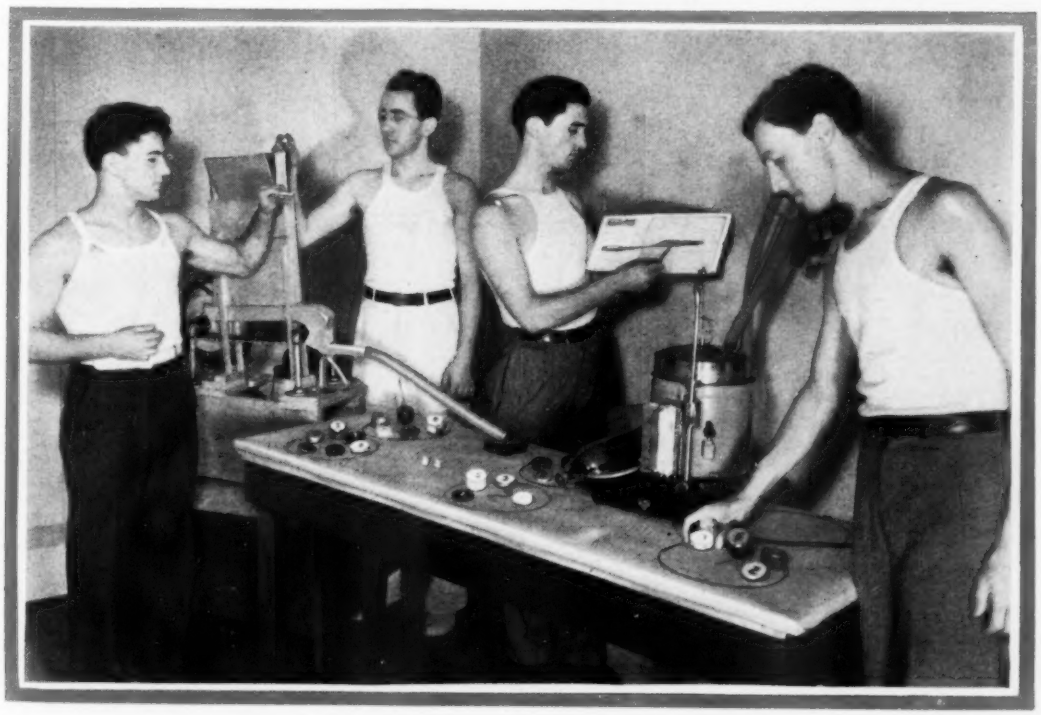
OF HEAT AND HUMIDITY ON WORKERS

Throws of the dice tell subjects what they are to do

By WALTER E. BURTON

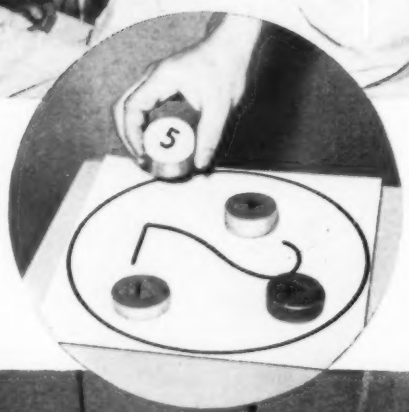
to giant proportions in our own New England States. Humidity gave the workers no discomfort there, because of the low average temperature. But in the South, where the textile industry has been migrating more recently, humidity plus heat add up to a more serious problem.

Just how much temperature and humidity can a worker stand without being harmed? To answer this question, the American Society of Heating and Ventilating Engineers has constructed a "sweat box" or heat-insulated test chamber within which high temperature and humidity can be accurately controlled. While subjects labor here at work simulating factory tasks, research workers periodically measure their body temperature, pulse rate, quantity of perspiration, changes in the blood, and other physical reactions, as shown on the following pages.



This set-up simulates work in a southern textile mill. The man at the right is placing weights according to throws of dice

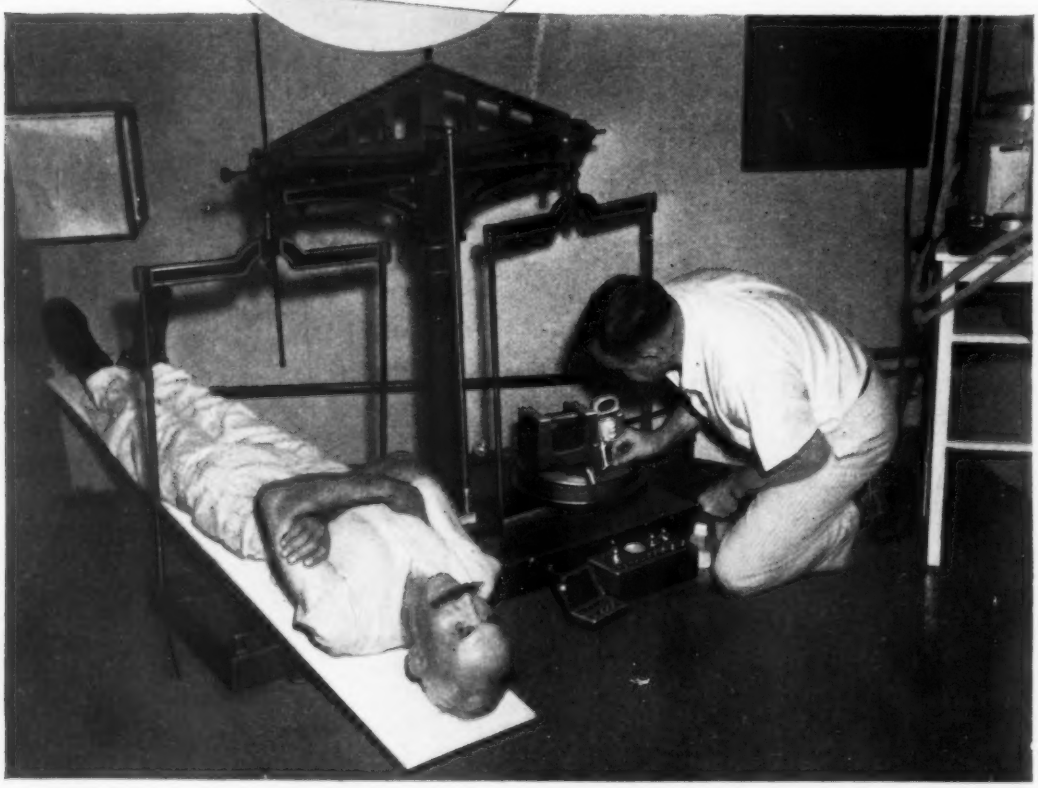
A subject getting a blood test. Increase of white corpuscles shows effects of work



At high humidity and temperatures, tasks like this are not easy

Since people soon learn to do routine work while mentally asleep, the master of ceremonies in this man-made hell, F. C. Houghten, has devised fiendishly ingenious tasks, that depend upon chance, to force constant alertness. You may see one of the subjects drop a brass marble into a hopper. Picked up by any one of a series of hidden buckets on a moving belt, the marble finally pops out of the machine and down a chute, anywhere from thirty seconds to two and a half minutes later. The subject must jot down the time upon a card. Then he tosses a pair of dice. The number on one die indicates which of six weights he must pick up; the number on the other die shows on which of six circles he must place it. This goes on for three to four hours. It sounds childishly simple, but it's real he-man's work when the thermometer sizzles at ninety degrees and the humidity stands at ninety percent.

For the first time, the tests reveal accurately just what happens when heat and humidity combine to torment you. Up go your body temperature and your pulse rate, the most



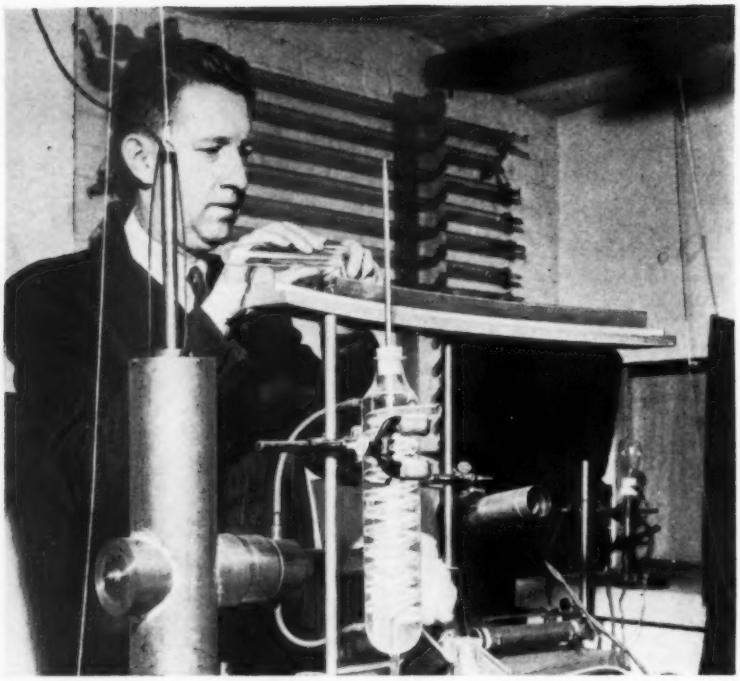
Human guinea pigs are weighed on scales sensitive to half an ounce after a session in the laboratory

significant of your body's numerous symptoms of distress. In a typical experiment, a 145-pound man spent four hours working in the "sweat box" with the temperature at ninety degrees, and seventy-five-percent humidity. His body temperature rose from 98.8 to 100 degrees. His pulse rate leaped from seventy to 120 beats a minute. White corpuscles multiplied in his blood. His respiration suffered. He lost more than three pounds of weight, mostly by evaporation of the perspiration that streamed from his body. Such profound physical effects, when allowed to proceed too far, are believed the cause of heat prostration—and, short of that point, of dizziness that impairs workers' efficiency and may lead to serious accidents.

A person in good health, scores of experiments indicate, should be able to work for three hours straight in a temperature of ninety-five degrees, with fifty-percent humidity; or at eighty-seven-degree temperature with humidity of ninety percent. For shorter periods, greater extremes can safely be endured. Houghten himself has worked thirty to forty-five minutes in 160-degree heat, with the humidity at ten percent. At the same temperature and ninety-percent humidity, however, only a few minutes' work could be done safely.

A technician takes a sample of blood from a subject's hand, which is thrust out through an opening in the cork-lined wall of the hot, steamy, man-made inferno

A door like that of a refrigerator separates the "hot room" from the anteroom where checking is done



Dr. Earl S. Johnston with his device for measuring chlorophyll in plants

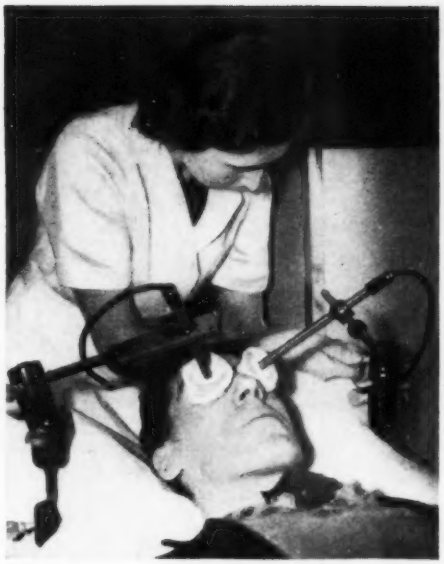
Shows Why Plant Life Is Green

TO AID scientists in solving the secrets of plant life, Dr. Earl S. Johnston, of the Smithsonian Institution, Washington, D. C., has perfected a delicate instrument that measures concentrations of chlorophyll, the green, life-sustaining coloring matter in plants, with an accuracy of one part in 10,000,000. When chlorophyll extracted from a plant is dissolved in a solvent, the amount of illumination that passes through this light-absorbing substance is measured to reveal the concentration.

New Crop Duster Is Carried on Tractor

MOUNTED directly behind the driver's seat of a tractor, a blower-type insecticide duster is a new weapon for farmers in their war on the boll weevil and other insect pests. Powdered poison carried in a hopper is blown by a fan operated by the tractor motor, out through an adjustable spout in a heavy, rolling cloud that is said to reach from sixty to eighty plant rows at one time. Whirling agitators within the hopper break up lumps in the insecticide powder and prevent it from packing down to clog the outlet.

Insecticide powder is blown out in a rolling cloud that covers sixty to eighty rows of plants at a time



Treat Inflamed Eyes with Radio Waves

INFLAMED eyes are now being treated with ultrashort radio waves in the Royal Westminster Ophthalmic Hospital, London, England. A large electrode is buried beneath the patient's pillow, while smaller electrodes, swathed in soft padding, are applied directly to his eyes, as shown above. Only a sensation of slight warmth is said to be felt as the six-meter radio waves, only slightly longer than those used for television broadcasts, perform their healing work.

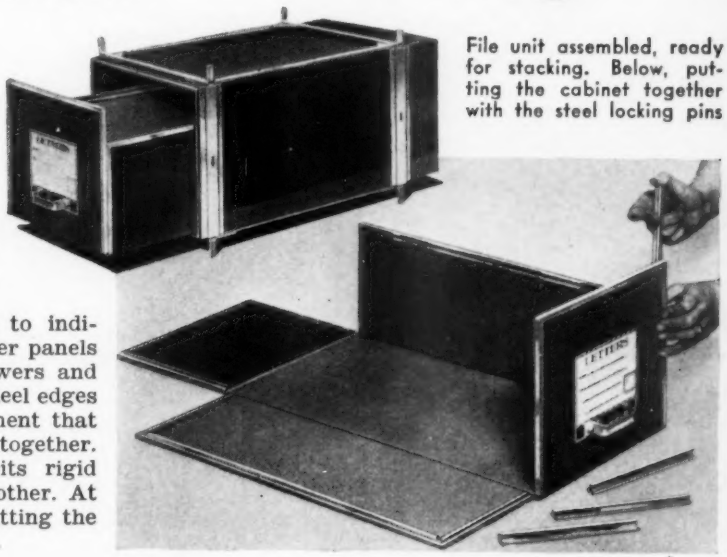
Cushion Counts the Bumps in New Car-Ride Analyzer

TO MEASURE road shocks and car vibrations transmitted to automobile passengers, Arthur J. Schamehorn, of Milford, Mich., has developed an ingenious "ride analyzer." A car driver sits with his back resting against an inflated rubber cushion connected through a rubber tube to a diaphragm within the housing of the recording instrument beside him. As car vibrations force the driver's body against the cushion, changes in its internal air pressure, as transmitted through the tube, cause the diaphragm to jiggle a recording pen across a moving strip of paper.

How the new "ride analyzer" is used in a car. Drawing at left explains operation of recording instrument

Filing Cabinets of Fiber Board Are Collapsible

FILING cabinets made of composition fiber board, that can be folded up for compact storage when not in use, are now available to individuals and offices. The fiber panels that make up the file drawers and cabinets have reënforcing steel edges and a locking-pin arrangement that make it easy to put them together. Steel frames hold the units rigid when stacked one upon another. At the right, the method of putting the cabinets together is shown.



File unit assembled, ready for stacking. Below, putting the cabinet together with the steel locking pins

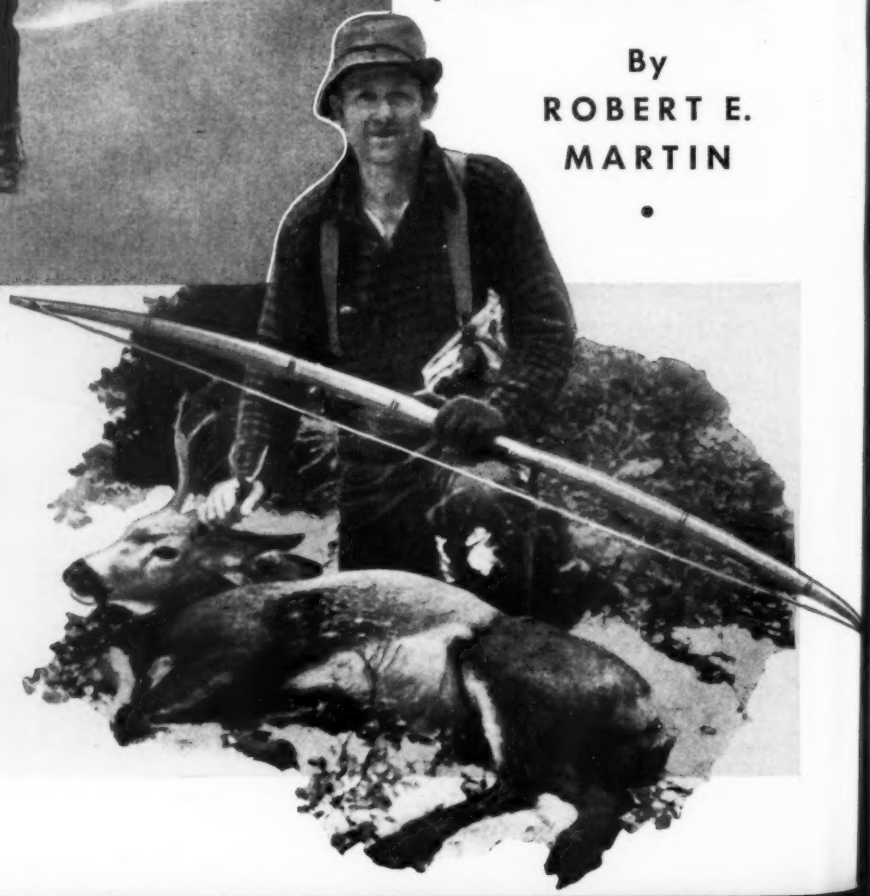
Happy

FOR BOW-

MARCHING silently through snow-covered highlands, a band of fifty hunters scanned the country intently in the hope of sighting a two-point buck. They walked softly, making no unnecessary sound or movement that might frighten game, for they knew that they must approach within close range in order to get in a killing shot. Instead of modern, high-power rifles they carried strong bows and quivers full of broadhead arrows.

These modern Robin Hoods were hunting over the Eight Mile Game Reserve in the State of Washington, newest of the happy hunting grounds set aside for the use of bow-and-arrow sportsmen. Eleven states now

By
ROBERT E.
MARTIN

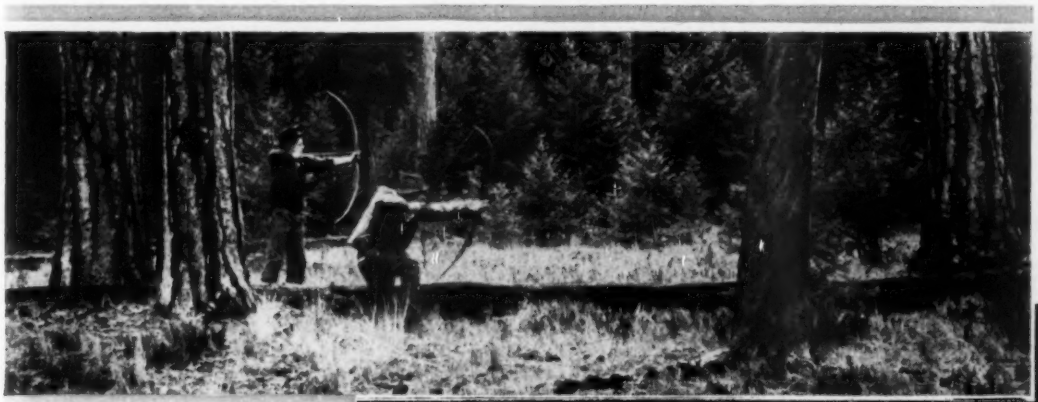


Robin Hood on skis. This is Kore T. Duryee, father of the Washington State reserve for bow hunters

I. M. Stamps, Seattle business man, smiles over a 150-pound, two-point black-tailed buck he brought down

Hunting Grounds

AND-ARROW SPORTSMEN



Two archers taking aim at a deer. At right, a hunter is reading one of the signs at the boundary of the reserve

EIGHT MILE GAME RESERVE
"FIREARMS PROHIBITED"
It shall be lawfull to hunt, take or pursue buck deer with branched antlers within the Eight Mile Game Reserve with bows and arrows ONLY
DEPARTMENT OF GAME
STATE OF WASHINGTON

maintain such twentieth-century versions of Sherwood Forest, in which firearms are not allowed and the twang of the bowstring replaces the bang of the rifle.

Late that morning, I. M. Stamps, Seattle business man, spotted a two-point black-tailed deer. Moving cautiously from tree to tree, he finally took careful aim at his quarry and drove a 1⅛-inch broadhead point clean through the shoulder.

Daddy of Washington's new game preserve is Kore T. Duryee, Seattle insurance man. For several years he had crusaded for a gunless hunting ground. Recently he sold State authorities on the idea, and now bowmen may roam at will through the eight-mile-long, heavily wooded reserve. Each may take one buck, provided it has branched antlers, but no bear or grouse. Hunters pay the customary State hunting-license fee, and may use any combination of bow and

Men and women join in the gunless hunting. Sometimes parties of fifty tramp through the forest after game

arrow, provided it has killing power. Bows with a forty-pound pull are the rule, with broadhead arrows of various widths.

Lying high above sea level, a half hour's drive north of Winthrop, Wash., and about 280 miles by road to the northeast of Seattle, the Eight Mile Game Reserve follows Eight Mile Creek from its source to its mouth in Chewack Creek. Ranging from four to seven miles wide, the park has an elevation of 3,000 feet at its entrance and rises to peaks as high as 8,000 feet. An automobile road runs through the middle of the reserve for most of its length, and only in rare instances does a hunter have to carry his game for more than two miles to his car.

Many archers take their families along on hunting trips, either tenting on regular camp grounds or driving in each morning from a lodge eight miles away. On week-ends, parties of as many as fifty hunters, men and women, tramp through the forest in search of game. On a recent hunt, 300 does and fawns were sighted before a buck was encountered.

Popularity of the gunless hunting preserves indicates that the idea will spread to other states.

Getting ready for the day's sport. Camp sites are provided inside the unusual game preserve

Choose Your Flavor in Lipstick

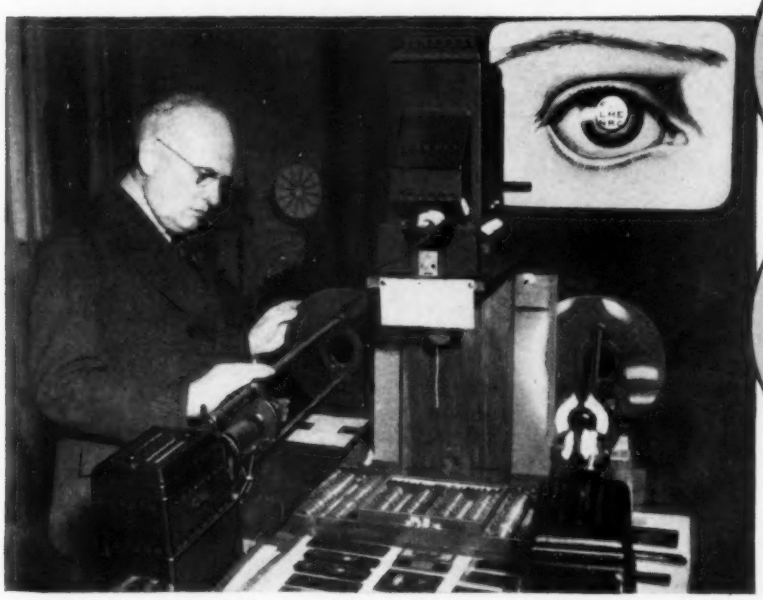
LIPSTICK, like gum and soda pop, can now be obtained in a choice of flavors to suit the taste of the user. The stick-form lip rouge is made in a wide variety of fruit and beverage flavors, including peach, apricot, rye, champagne, banana, and pineapple. The three young women at the right are making a taste test of orange, wine, and pineapple lipstick.

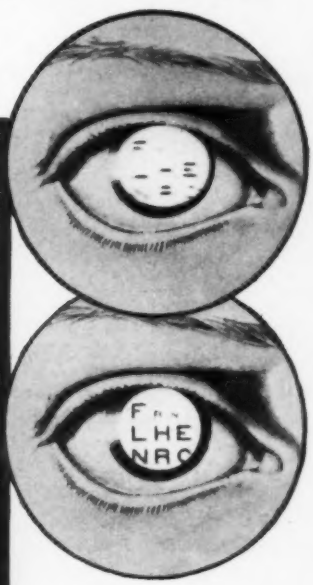
These young women are testing lipstick in assorted fruit and beverage flavors

Mechanical Eye Imitates Visual Defects

WHAT does a highway traffic sign look like to a motorist suffering from astigmatism? To answer this question for persons having normal vision, Frederick Hamilton, of Providence, R. I., developed a novel mechanical eye. Two matched projectors produce an image on a screen. Special lenses are then introduced to distort the picture just as a defective human eye distorts the images that it receives and transmits to the brain. The instrument shows how dangerous automobile driving could be for motorists with visual defects. Unless they wear glasses, sufferers from astigmatism, for example, see some parts of the lettering on a highway warning sign more plainly than other parts.

Lenses used in this projector duplicate various eye defects





This is how letters look to a person of normal vision. Above, as seen by a person suffering from astigmatism

King of

HOW A COWBOY ARTIST IN AMUSING CARTOONS

Two of "Andy's" creations, a New Mexico sheriff and his deputy. They got their man—he's inside the box

Herbert S. Anderson at work in the studio where he carves his world-famous caricatures in wood

AS A BOY, on a cattle ranch in western Colorado, Herbert S. Anderson became addicted to whittling. When he was five, a cowboy gave him a pocketknife for a birthday present. A few days later, when his father found him whittling a stick, Herbert received a stern lecture upon the evils of whittling. "Boys who whittle," his father assured him, "usually grow up to be idlers and ne'er-do-wells." Several years later Herbert Anderson received similar advice from a sixth-grade school teacher, who frankly told him that he was the dumbest and laziest boy in Colorado, after he'd been caught in the act of whittling behind his desk in the school classroom.

Nevertheless, "Andy" went right on whittling. He whittled wherever he followed the chuck wagons, whenever he wasn't busy riding the range, roping and branding steers, breaking horses to the saddle, or performing similar duties of his cowpuncher boyhood and youth. By the time he was twenty he had become sufficiently skilled with his pocketknife to carve grotesque-looking cowboys, funny old Indians, rawboned horses, and other familiar figures out of blocks of wood. These he passed around among his cowboy associates, just to hear the peals of laughter they invariably brought forth.

At the age of twenty-five, Anderson made a trip to Denver and for the first time in his life saw street cars, paved streets, and congested motor traffic. The city terrified him, and his first trip through the downtown streets at the wheel of an old Model-T Ford left him so shaky in the knees that he had to get a drink to steady his nerves.

In the saloon, as he sipped his "tonic," he exhibited some of the pieces he had carved

the Whittlers

CARVED OUT A FORTUNE "DRAWN FROM THE WOOD"

Popular cartoon characters inspired this hillbilly group, executed for a famous movie star. Note the dog and the rooster

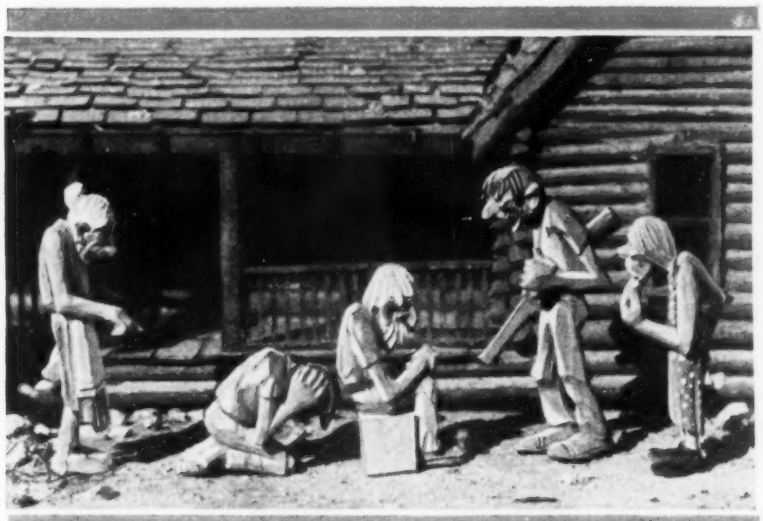
By JOHN EDWIN HOGG

—cowpunchers, Indians, horses, and cows. A group of men along the bar roared with laughter as they examined the products of "Andy's" handicraft. An elderly fellow elbowed through the huddle, tapped the whittling cowboy on the shoulder, and croaked into his ear: "Say, lad! If I could whittle like that, I'd high-tail for Hollywood. Those movie folks out there buy things like that—and they pay a lot of heavy dough!"

Anderson, during all his years on the cattle range, had always dreamed that somewhere, somehow, he'd find some way to make a lot of money easy. And so, a few months later, he stepped from a train in Los Angeles.

If he had found Denver noisy and bewildering, Los Angeles seemed like all hell turned loose! "Andy" couldn't quite believe it when a friendly policeman told him that the nearest large motion picture studio was fifteen miles from the railroad station—and still in Los Angeles. Nevertheless, with the aid of an old negro whom he hired as a guide, he eventually got to Hollywood to make the pleasing discovery that the mining man in the Denver saloon had given him sound advice.

"Yes," said the personnel manager at a well-known motion-picture studio, "we can use a fellow who's as handy with a pocket-knife as you seem to be." Then he named a weekly salary that sounded to "Andy" like the combined monthly pay of about a dozen ranch hands. The whittling cowboy promptly accepted the offer. Many months later, some word about "Handy Andy," as he became known around the movie lot, got to the ears of Walt Disney, who lost no time in hiring him away from his first employers. It seems, now, that the whole motion-picture industry failed to recognize in this tall, lean, rawboned, ham-handed, whittling cow-



A mountaineer drama in wood. The human figures are only five inches tall

Anderson's mountain hide-out. At the left is "Old Pete," a life-size wooden Indian. The carved figure looks so real that visitors often speak to it

boy the world's first, one-and-only jackknife cartoonist.

Today, Herbert S. Anderson is copyrighted; the cowboy who whittled to the despair of his parents and teachers, has literally whittled his way to fame and fortune. His work is known and makes people laugh from one end of the country to the other. He still loathes cities, and that is why he lives at a delightful country estate tucked up in the foothills of the Malibu Mountains some miles from Calabasas. Up in this mountain snuggery, where he lives behind snakeproof fences in a land well populated with rattlesnakes, deer, mountain lions, and bobcats, the whittling cowboy at work in his studio slashes basswood blocks for six or eight hours each working day—at how much a slice nobody but "Andy" and the income-tax collectors knows!

Luckily for him, perhaps, his output is limited to his own fairly high speed at making the chips fly. No other living person has yet succeeded in learning to carve western characters with the grotesque and humorous cartooning he puts into his work. Nobody can duplicate it except by casting it, and they can't even do that without a pay-off under the whittling cowboy's copyrights. Thus "Andy" finds himself in much the same position as the man who can paint a better picture or build a better mouse trap. As for competition—if he has any, he hasn't found it yet.

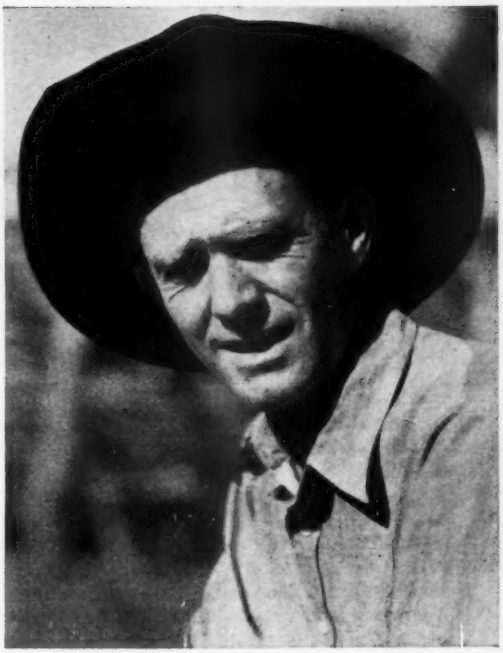
The outstanding characteristic of "Andy's" extraordinary whittling is his ability to produce cartoons in the form of images carved from wood. He attempts nothing of beauty; all his work is homely, grotesque, and amusing. Every piece he carves literally bulges with that mysterious something that is broadly defined as "human interest." He goes out for the accentuation of human and animal characteristics, using miscellaneous knives and chisels upon blocks of wood just as J. N. ("Ding") Darling, Herbert Johnson, and other famous cartoonists bring them out with strokes of a pen. One of his best sellers today is "Old Tex," a subject he carved some twelve years ago.

"Old Tex," if you're familiar with him

from copies in tens of thousands of American homes, in art stores, novelty shops, and shop windows all over the country, is an old Mexican *vaquero* who used to ride the range with "Andy" in Colorado. He's a snaggle-toothed old duffer, wearing a big sombrero tilted back on his head, and a week's growth of beard. His nose is red, he's twanging a guitar, and he looks as if he had enough *tequila* (Mexican cactus liquor) to be singing at the top of his raucous old voice a few minutes before time to close the saloon. "Old Tex" has made a tidy fortune for "Andy," and the copyright royalties are still rolling in.

Having grown up in the cow country where there are many Ute and Navajo Indians, Mexicans, and picturesque Americans of European descent, "Andy" has an inexhaustible stock of memories for the subjects he carves in wood. He not only knows cow-country people, but every detail of character, costume, and custom that makes them a race apart from other people of the world. To bring them to life from a block of basswood grown in Maine, a few skilled strokes with his razor-edged tools accentuates a pair of legs bowed from years in the saddle, slumped shoulders, a bulge in the midriff, a pair of knock knees, buck teeth, a bald head, a misshapen nose, or the slightly toed-in moccasins on the feet of an Indian. Every little detail is visualized before he makes the first cut.

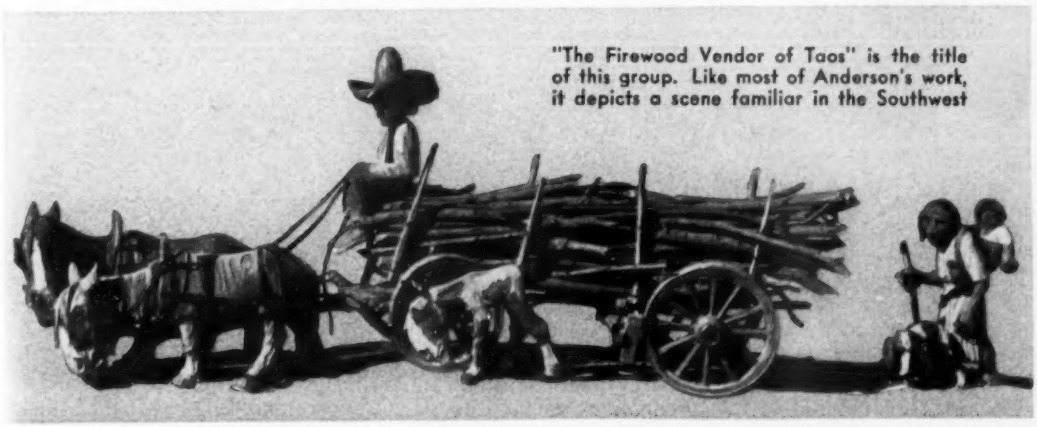
When he whittles animals, "Andy" cartoons horses, cows, dogs, or even pigs or chickens just as effectively as he does humans. Art critics who have studied his work have proclaimed that he knows equine anatomy as thoroughly as ever did America's three greatest painters of horses—Frederic Remington, Charles Russell, and the late Frank Tenney Johnson, who died a few days before these lines were written. But, unlike those famous painters of horses, "Andy" is never interested in sleek, well-rounded specimens of grain-fed horseflesh. When he carves



"Andy" himself. He stands six feet four inches high

horses he carves plugs, the most disreputable-looking beasts—horses just a little better than the type commonly known as crow bait. It is this sort of caricaturing that makes his horse figures so ridiculous and so fascinating. Few persons can look at any group of them without recognizing some familiar, old nag they have known in Iowa or Illinois or elsewhere.

"Andy" still pretends to be the dumbest man who ever flunked out of the sixth grade of a cow-country school. But from knowing him rather intimately, I suspect that his assumption of a very dull mentality is an unadulterated pretense—part of his stock in trade. By acting dumb, going about in cow-



"The Firewood Vendor of Taos" is the title of this group. Like most of Anderson's work, it depicts a scene familiar in the Southwest

A funeral. Hired mourners hold onions in their handkerchiefs

boy boots, blue jeans, blazer shirt, and two-gallon hat, and refusing to don street clothes even for his occasional business errands into Los Angeles and Hollywood, he gives people the opportunity to find out for themselves what a clever artist and smart business man he really is.

Every one who sees his work longs to own a few pieces of it, and since he can never hope to supply more than the smallest fraction of the demand for originals, every available piece is snapped up by the highest bidders. Some months ago, a wealthy Englishman paid a small fortune for a lot of representative pieces and bundled them off to the Royal Academy of Arts in London. A wealthy man from Honolulu talked a colder kind of turkey with a cash offer for everything "Andy" produced during three months of 1937. More recently, one of the big tire manufacturers of Akron, Ohio, wrote his check in four figures to hire "Andy" for a month to whittle a batch of subjects to be handed out as Christmas presents.

Millions of Americans without fat bank rolls can own nothing of "Andy's" art save the low-priced, molded reproductions of some of his masterpieces sold under his copyrights throughout the nation. The royalties from such sales, of course, are only a few cents each, but when they are made by the tens of thousands each year—and the royalties from some pieces are still rolling in after twelve and fifteen years—it would appear that the whittling cowboy is realizing his youthful dream that some day, somehow, he'd find a way to make a lot of money easy!

In Herbert S. Anderson we seem to have proof of the old adage that artists are born, not made. Although he has carved a name for himself—literally whittled his way to fame and fortune—he has no background in the field of art. As an artist with pen or brush, he's little more than a total loss. Almost any schoolboy could draw a better picture of a horse than "Andy" could put on paper, but with a few strokes of his tools he can pull a horse out of a block of basswood like a magician hauling a rabbit out of a hat.

The best laugh I've had in months was watching "Andy" whittle a horse to show me how he does it. With a pencil he roughed the outline on a piece of wood, making the sketch twice as big as the horse he intended to carve. Then he tore into the wood with his knives and chisels like a poodle digging for truffles. His workbench was soon littered with chips and out of the block of wood emerged the sorriest piece of horseflesh imaginable—a sway-backed, rawboned, spavined critter that looked for all the world like something salvaged from the glue works.

When "Andy" came to California in 1927, he had never earned more than fifty dollars during any month of his life. He was broke when the depression bounced him out of the motion-picture industry in 1930. But the lack of a job never worried him. He went right on whittling *(Continued on page 232)*

Here we have an English fox hunter in Colorado. The fox is up on the bowlder

One hand is left free for emergencies as the policeman uses his flash-light billy

Policeman's Billy Has Built-In Flash Light

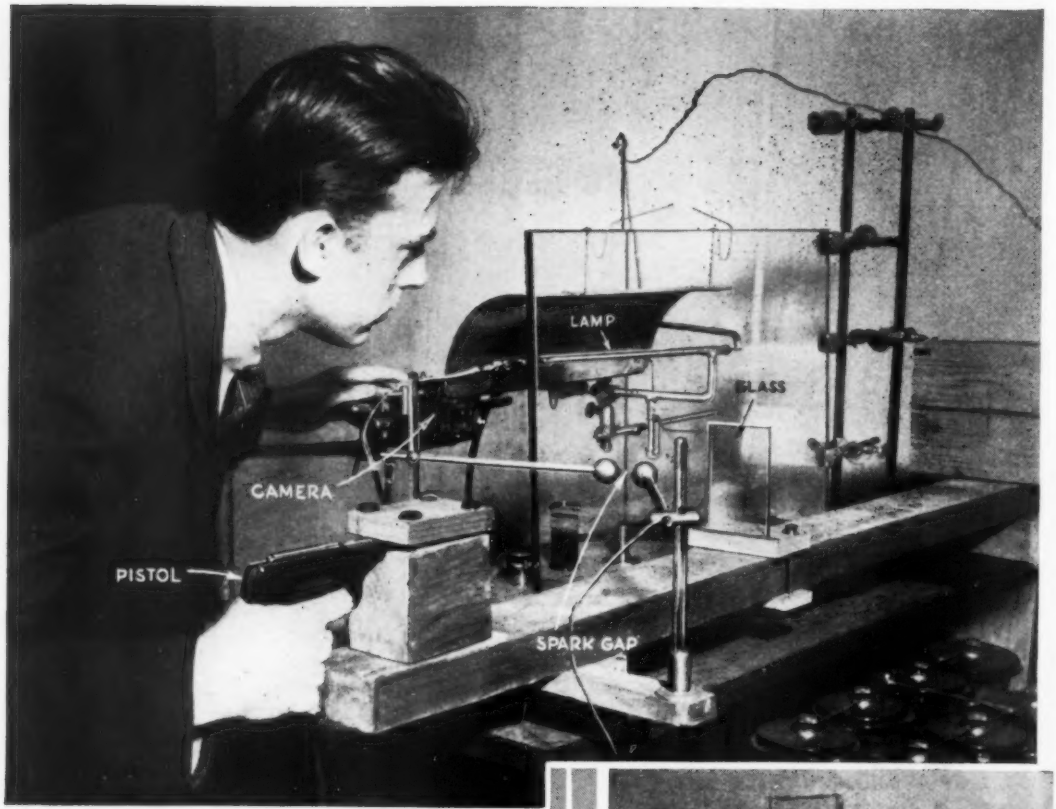
FLASH LIGHT and night stick are combined in a single unit that leaves policemen and watchmen with one free hand in nighttime emergencies. The wooden billy, strong and rugged in construction, is hollowed out to accommodate two dry cells and a light bulb that throws a beam from the end of the stick when a built-in switch is pressed.

The bulb, lens, reflector, and cells are well cushioned to withstand severe shocks and rough handling.

Flexible Gas Tank for Airplanes Is Made of "Rubberized" Fabric

SUCCESS in the search for a lightweight, leak-resistant gasoline tank for airplane use has just been reported by Baltimore, Md., aeronautical engineers, with the announcement of a tank made of fabric specially impregnated with a synthetic rubber. Designed to fit into wing, fuselage, or pontoon compartments, the fuel cells have withstood more than 700 hours of destructive vibration on a mechanical testing machine designed to destroy the usefulness of any metal tank within fifty hours. During this torture test, it was said, the structure supporting the fabric tank had to be repaired several times, but the impregnated fuel-cell material remained undamaged. If the tank is deliberately pierced by bullets or a sharp tool, it can be repaired to its original strength, much as an inner tube is patched.

This tank-testing "torture table" failed to harm one of the new fabric tanks in a 700-hour workout. Inset shows how the cell fits in space in a plane wing



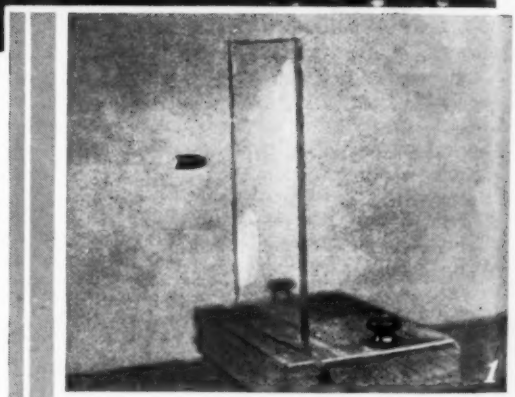
A bullet snaps its own picture with this set-up. Gases from the gun allow an electrical charge to jump the gap and fire the flash lamp

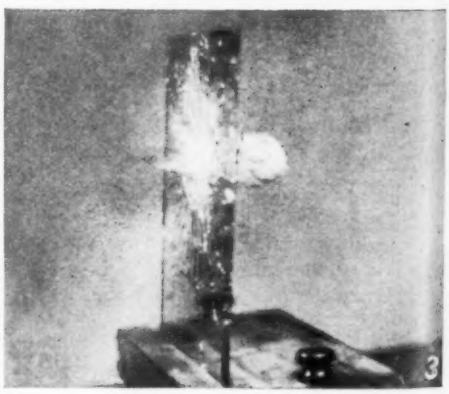
Split-Second Snapshots

NEW HIGH-SPEED METHOD STOPS BULLETS IN FLIGHT

BY APPLYING a hitherto unused principle, experimenters at the Armour Institute of Technology, in Chicago, are taking millionth-of-a-second snapshots of speeding bullets with a standard miniature camera.

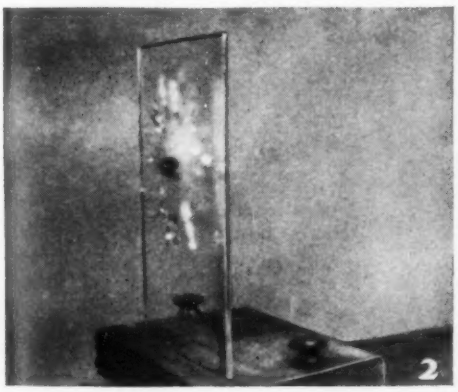
For one of their superspeed pictures, a research worker fires the bullet past a spark gap which is wired in the same circuit with a tubular lamp containing a partial vacuum. The twin balls of the spark gap have been set just far enough apart so that 38,000 volts of

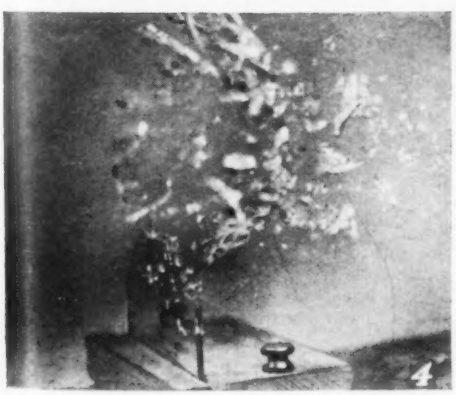




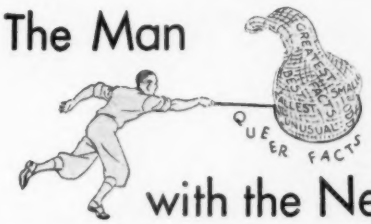
electricity cannot leap across the air space and light the lamp. A split second after the bullet goes by, however, the powder gases from the gun reach the spark gap and envelop it. Since these gases are better conductors of electricity than air, a spark jumps the gap and completes the circuit, momentarily lighting the lamp. The camera, with its shutter left open, records the bullet's picture by the light of this brief flash. Thus, the simplified new method dispenses with auxiliary means for timing the flash of a lamp or spark employed in earlier experiments of the kind, such as breaking an electric wire with the bullet or firing it through a magnetic field.

Dr. F. W. Godwin and Dr. A. O. Walker, who perfected the latest scheme, have applied it to reveal what happens when a bullet strikes a pane of glass. Four of their remarkable photographs are reproduced below. In the numbered order, the views show the approaching bullet; the bullet halfway through the glass, in which cracks are beginning to appear; the emerging bullet surrounded by a cloud of pulverized glass; and the pane flying to pieces after the bullet has passed. A separate pane of glass was set up for each view, and the timing was altered for the exposures by the placing of the panes.





The Man with the Net



OPTICIANS *estimate that 1,410,000,000 lenses would be required to correct all the defects possible in human eyes.*

COAL, *in some form of deposit, lies under approximately three fourths of the State of Illinois.*

PULVERIZED *grasshoppers are being tried as a substitute for gasoline in a German experimental motor.*

AVOCADO OIL *forms the base of a new soap produced in Guatemala.*

AIRPLANE *engines of 1,500 horsepower use nearly five tons of air an hour during operation.*

TERMITES *have been eating wood for at least 10,000,000 years.*

ANESTHETICS *used in Pennsylvania hospitals last year cost nearly $1,000,000.*

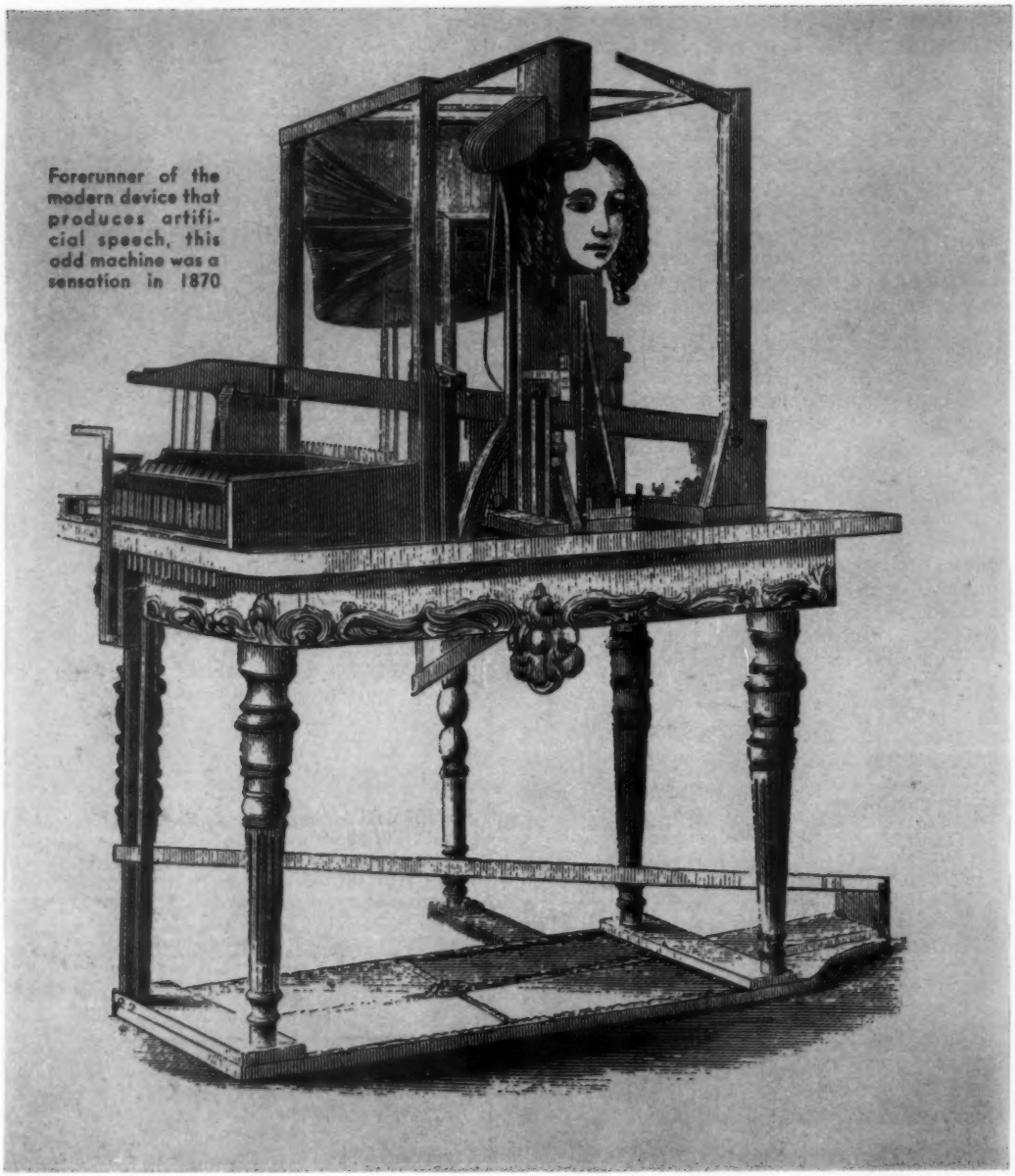
RATS AND MICE *destroy in one year in the United States goods equal to the earnings of 200,000 men.*

HANDS *on Big Ben, London's famous tower clock, travel 100 miles a year.*

SIXTEEN SEVENTEENTHS *of the people of Greenland live on its west coast.*

AMERICANS *buy half the world's silk.*

ALFALFA *juice is being used as a medicine to prevent hemorrhages.*



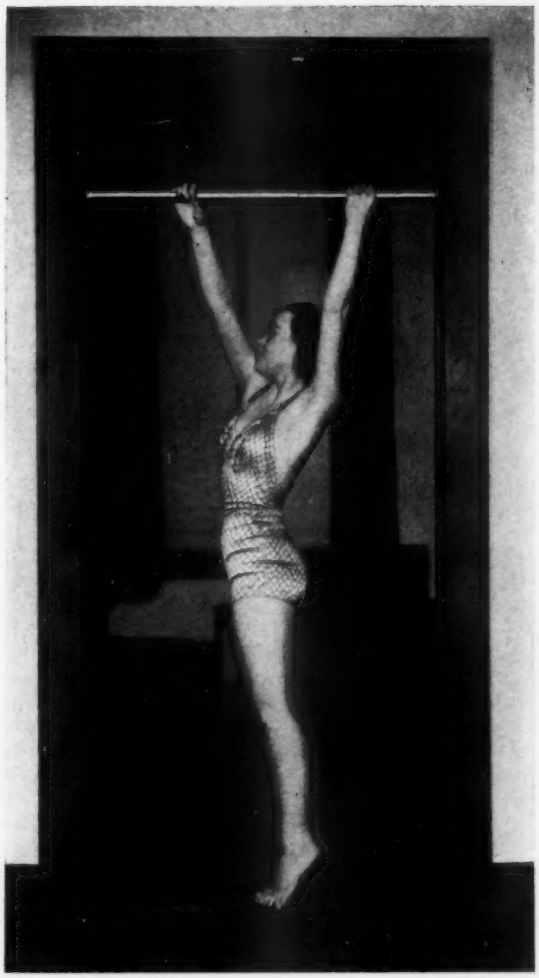
Forerunner of the modern device that produces artificial speech, this odd machine was a sensation in 1870

Grandmother of Pedro the Voder

IF A certain Professor Faber could listen to "Pedro the Voder," the amazing new machine that produces artificial speech with vacuum tubes (P.S.M., Apr. '39, p. 72), he would see the realization of a dream that haunted him a lifetime. For forty years this Austrian experimenter labored to create a machine that could talk. His nearest approach to it, by 1870, was the remarkable contrivance above. When he worked a foot-powered bellows and various controls, the rubber lips of the mask uttered something faintly resembling syllables. He tinkered with the mechanism until it could produce fourteen different alphabetical sounds, and even attempt a word or two. Crowds flocked to see this early forerunner of the present-day marvel of synthetic speech.

Doorway Exercising Bar Is Easy To Install

INSTALLED without screws or nails, a novel exercising bar turns any doorway into a home gymnasium. Twisting the ends of the bar forces rubber suction cups against the door frame tightly enough so that the bar will support 250 pounds.

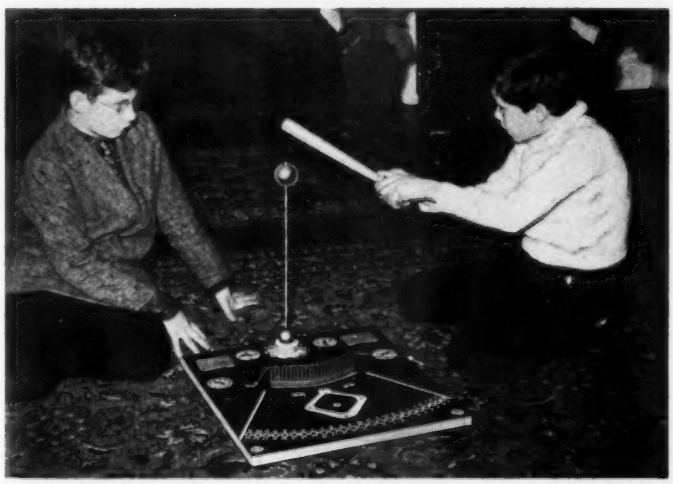


Twisting the bar forces it firmly against the door frame

Low-Cost Supercharger Takes Breeze from Fan

A LOW-COST supercharger that has no moving parts is now available to motorists for increasing the efficiency and economy of their car engines. Attached to the carburetor, the unit has a built-in air cleaner, and insures a full charge of air for the cylinders from the engine fan.

The supercharger installed. It catches air from the fan and concentrates it on carburetor intake



Batter up! His swat determines the fate of a "runner" on the board

Indoor Ball Game Uses Real Bat

IN A new indoor baseball game, players have the "outdoor" thrill of swinging a miniature bat at a real ball. The latter is attached to a steel rod which swings down into one of the spaces between a fencelike row of twenty-four rubber pickets. A number at the base of each picket opening tells the player how to move pegs representing base runners, around the playing board. In the illustration at the left, two youthful contestants are trying out the game.

New Breeding Methods

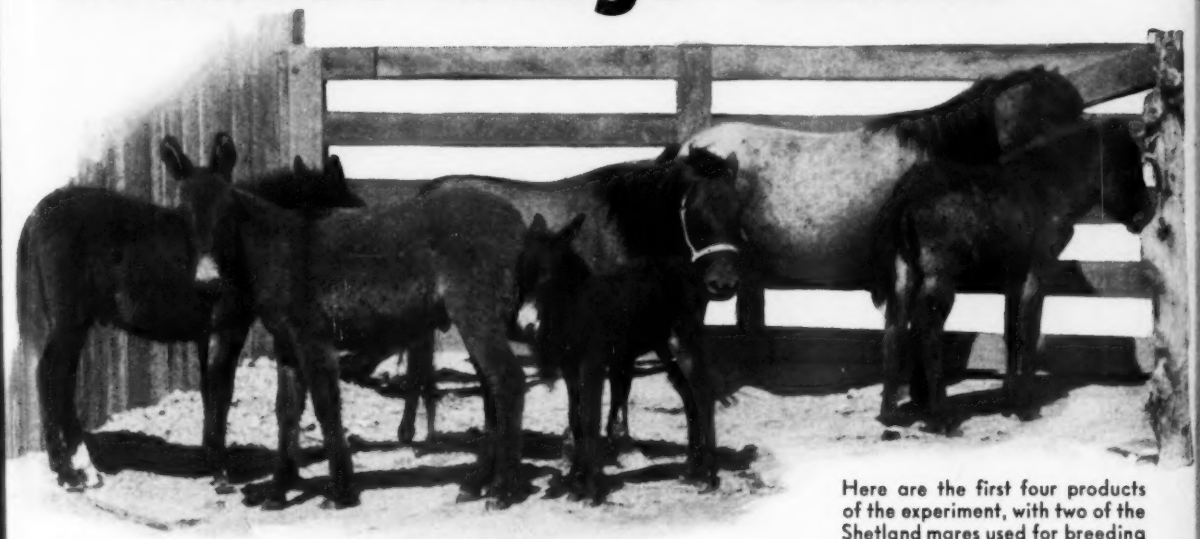
FROM a dwarf donkey, bred with Shetland ponies, has just sprung a new race of midget mules. The latest curiosities of the animal world seem likely to bring a tidy profit to their breeder, Lex Watson, of Columbia, Tenn. Shows and circuses want them for exhibition, and mining men are interested in them for more practical reasons, since their Tom Thumb stature especially adapts them to pulling mine cars.

The story began, not long ago, when Watson acquired an exceptionally small male donkey. A perfectly formed specimen of the "Maltese" variety, with hair of the same blue-gray color as that of a Maltese cat, this four-year-old stands scarcely six inches higher than a yardstick, and weighs only 325 pounds. Now, a mule is the hybrid offspring of a donkey and a horse, and Watson owned ninety or more Shetland ponies, mostly brood mares. So he decided to try to produce "the smallest mule in the world."

How likely he is to succeed can be seen from the results of his first crossbreeding trials with Highland Canary, the dwarf Maltese donkey. Ordinary mule colts, when foaled, range from forty to fifty inches in height and ninety to 100 pounds in weight. But Jackrabbit, the month-old daughter of Highland Canary and a Shetland mare, measures a fraction over twenty-four inches in height and weighs only forty pounds. Place a half dollar under her hoof, and a rim of silver is plainly visible all the way around. Her color and form leave nothing to be desired as a typical Tennessee mule. She can, and does, kick like her big cousins, and for about the same reasons. Yet she will trot along behind you like a dog if you scratch her ears or pay her other small attentions. Jackrabbit has two brothers and a sister, so far.

Jackrabbit, a midget mule foal. Her sire, at right, is a dwarf Maltese donkey

Produce Midget Mules



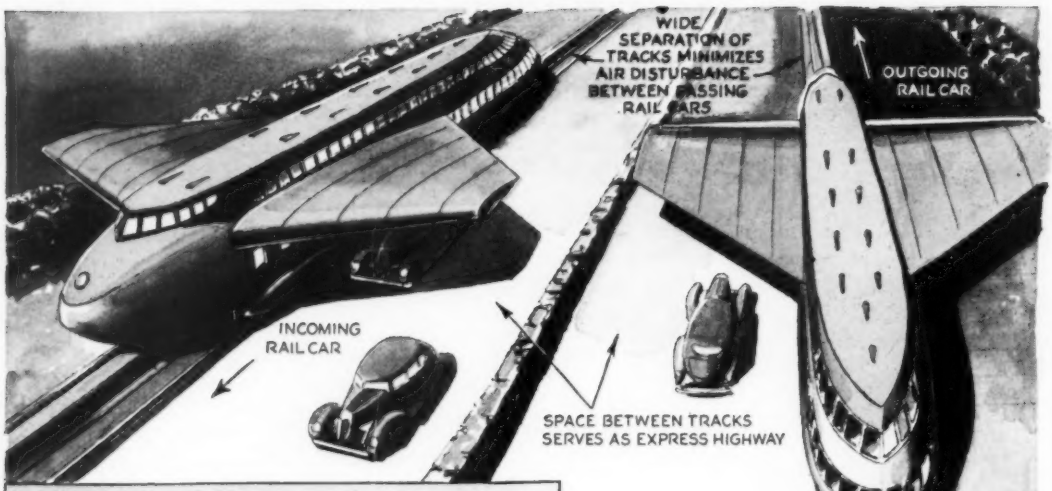
Here are the first four products of the experiment, with two of the Shetland mares used for breeding

The eldest, a year old and rapidly approaching maturity, still is only a yard tall and weighs less than 200 pounds. Watson expects all four will be little if any larger than their sire, Highland Canary, when they attain full growth, which will be within a few months.

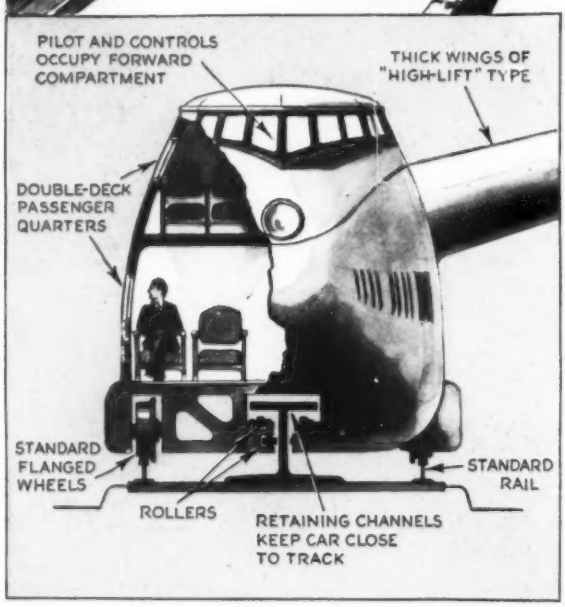
He will have to make the most he can of Highland Canary's first generation of offspring, for the strain of midget mules cannot be perpetuated. Mules are proverbially incapable of reproducing their kind. But Watson will be satisfied if Highland Canary fathers a large family for sale and exhibition.

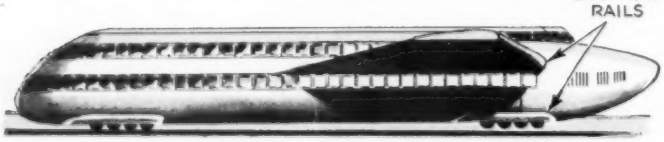
The big and little of muledom—Jackrabbit with a full-grown common mule

At the left, the little foal poses for a close-up with her mother, a Shetland pony mare


WIDE SEPARATION OF TRACKS MINIMIZES AIR DISTURBANCE BETWEEN PASSING RAIL CARS
OUTGOING RAIL CAR
INCOMING RAIL CAR
SPACE BETWEEN TRACKS SERVES AS EXPRESS HIGHWAY

Broad motor highways fill the area between the tracks. The rail cars, as indicated at the left, are double-decked





At high speeds, the front wheels leave the rails, reducing friction

Winged Rail Car Rides on Air

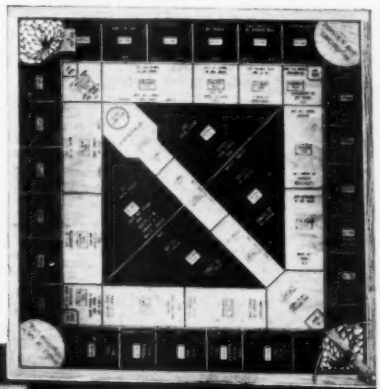
CAPTIVE airplanes with clipped wings would hurtle across country at more than six miles a minute, in a "flying-railway" system proposed by a European engineer. His scheme calls for a giant new type of streamline passenger car, having stubby wing surfaces and a body like the fuselage of an airplane. At low speeds, as in starting and stopping, the vehicle rolls along standard rails on flanged wheels at front and rear. Under full throttle, however, the whole front of the car rises from the track and, lifted by the wings, rides on air, so reducing friction that speeds up to 400 miles an hour may be attained. Retaining channels and rollers prevent the forward or "flying" end of the car from zooming dangerously high. Meanwhile the rear wheels, remaining in contact with the rails, continue to supply propulsive force from the vehicle's Diesel power plant. Passenger seats are arranged in pairs on the double decks of the curious train, while the engineer-pilot sits high in the front of the vehicle in a special cockpit resembling that of a modern transport plane. The space required between tracks, to allow clearance for cars traveling in opposite directions, would be used as an express automobile highway.

Handy Pantry for Trailer Hangs on a Nail

ONE nail is all that is needed to support the compact trailer pantry pictured at the left. Fastened to the wall of a trailer at the kitchen end, the wire framework holds six plates, six cups, and six saucers, and keeps them from jiggling or rattling when the trailer is in motion. The device was invented by Mrs. Rose Lang, of Buffalo, N.Y., who has more than 100 inventions to her credit.

Ball Fans Get New Table Game

BASEBALL fans can start their spring training with a novel baseball game now on the market. On a board marked off like a conventional baseball diamond, one player shoots a ring representing the ball toward home plate, where his opponent attempts to hit it with a small pivoted bat. If the ring is struck safely, the player at bat moves markers representing base runners in accordance with directions printed on the square where the batted ring lands. Detroit American League players are shown below trying the game.



Members of the Detroit Tigers take a busman's holiday with the new game. The playing board is seen above

Collector Hoards Used Pencils

COLLECTING used lead pencils is the novel hobby followed by E. H. Casburn, of Fort Worth, Tex. Steadily mounting in numbers, the odd collection includes pencils that have been used in official capacities by the governors of thirty-one separate states. Casburn stopped counting away back when his total number of pencils reached 200—he believes counting them is bad luck—but he has set his goal at 1,000,000, and if the small avalanche of stubs that pours in on him is any indication, he seems likely to achieve it.

Some of his specimens have very strange histories. One was used by W. Orville Beal, of Forth Worth, to sign his own death certificate. Some years ago, Beal was stricken with a serious illness, and at ten o'clock one morning he was apparently dead. Later that day his mother signed her son's death certificate and also a contract for a cemetery plot and tombstone. But at four o'clock the following morning, the "corpse" revived, rallied, and noticed the death certificate lying near the bed. As a joke, Beal picked up the same yellow pencil his mother had used and signed his own death certificate.

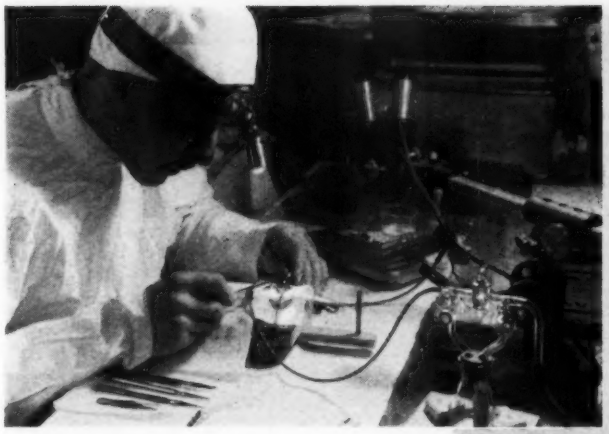
From long and careful examination of the pencils in his collection, Casburn feels that he has found a way to tell the temperament and personality of any person just by studying a pencil he has used for a few days. A pencil bears a close relation to the person who uses it, the collector states, for it is the first means provided him as a child for expressing himself in writing, and is his constant companion throughout life.

Men, he has discovered, most frequently use yellow pencils—twenty-nine of the thirty-one governors' pencils are yellow—and the erasers are generally in good condition. Women, on the other hand, select pencils in widely varying colors, the erasers are usually chewed and well worn down, and the wood is often marred by tooth prints. Children's pencils may be any color in the rainbow, and often have special, elaborate erasers.

With each addition to the collection that comes in by mail, Casburn usually receives a letter or short note from the sender, which means that he has practically as many autographs as he has pencils.

E. H. Casburn with some of the hundreds of pencils in his collection

Pencils of Vice-President Garner and Governors Lehman of New York and O'Daniel of Texas



Midget operating table and anesthesia apparatus are used in operating on the mice. Movies are made with the camera above

Operations on Mice Aid Cancer Study

STERILE surgical technique with careful administration of anesthetics with midget equipment is being used by medical experts of the National Cancer Institute in Washington, D. C., during experimental operations on mice. As shown above, the anesthetized animal is laid on a miniature operating table with its body shrouded in sterile gauze, and with the exposed operating area bathed in strong light from the surgeon's forehead lamp. Motion pictures of successive stages of cancer in mice are taken with the apparatus pictured at the right.

A ship's doctor tries oxygen on a passenger to cure her seasickness

Oxygen Treatment Is Tried Out as Seasickness Cure

SEASICKNESS and other forms of nausea may be cured with oxygen treatments, according to Dr. Walter M. Boothby, of Rochester, Minn., who recently conducted experiments on seasick patients during a cruise of the Canadian liner *Lady Nelson*. The patient wears a face mask of the type that leaves the mouth exposed, permitting her to talk or eat, while oxygen is fed into the nose section of the mask through rubber tubes.

Latest Ideas

There's no guesswork with this printer. Switches control the exposure of a print to any predetermined degree of contrast

Automatic Enlarger for Miniature Film

INGENIOUS use of two photoelectric cells and a novel electric circuit containing a radio tube, in a new miniature-film printer, permits the amateur to make accurately timed enlargements from his negatives quickly and cheaply. The 2¾" by 4¼" prints may be of contrast, medium, or soft effect, as desired, on hard, medium, or soft paper. Two levers, one for the type of printing paper, and one for the desired effect, are set by the operator, while a third control serves as a starting switch. The light-sensitive circuit thereafter controls the amount and duration of the light reaching the paper through the negative.

Synchronized Flash Gun Fits Focal-Plane-Shutter Cameras

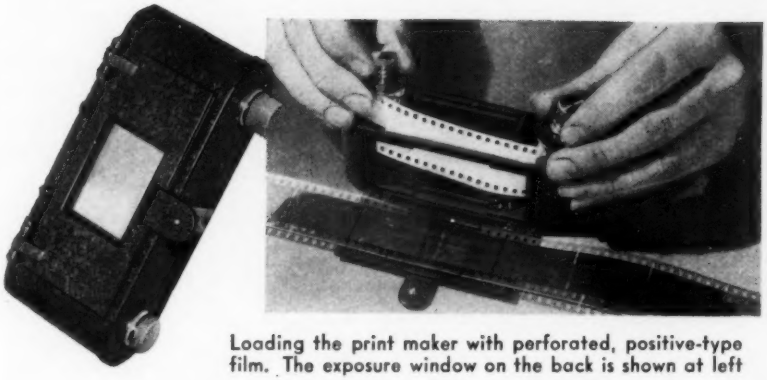
PROVIDED with calibrated control for different speeds and photoflash-bulb types, a new flash gun for cameras with focal-plane shutters is claimed to give perfect synchronization between bulb and shutter. The unit is designed for use with any standard battery case and reflector mount, and attaches directly to the body of the camera, fitting over the shutter-winding knob. Compact and foolproof, the mechanism does not interfere with the use of other camera accessories. It is completely inclosed and permits synchronized flash-bulb pictures at speeds up to 1/1,000 second, according to its manufacturer.

The flash-gun unit is mounted on the winding key of the focal-plane shutter

Dial-Type Switch Times Enlarging Exposures

A DELAYED-ACTION switch that operates on the principle of the dial mechanism of a telephone controls the exposure time up to one minute while making enlargements, leaving the operator's hands free for print control and other details. Plugged into a wall outlet and connected into the enlarger's lamp circuit, the unit closes the circuit when it is twirled with a finger tip, permitting the lamp to remain lit for any desired period within sixty seconds.

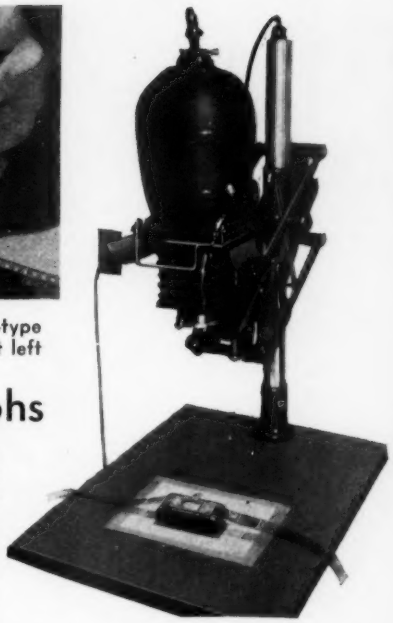
for Photography Fans



Loading the print maker with perforated, positive-type film. The exposure window on the back is shown at left

Printer for Small-Size Photographs

RESEMBLING a midget camera, a handy printer recently placed on the market is designed for making contact prints of miniature negatives on either positive film or positive paper strips, the latter either perforated or unperforated. A hinged lid, fitted with a glass exposure window, presses a frame of the negative strip against the positive film or paper, and light is admitted from an enlarger or other source to make the exposure. The printing strip is moved from a storage reel to a take-up spool by means of convenient knobs, while a ratchet wheel clicks as the film is moved, indicating by sound when a new frame is in position for exposure.



The light from an ordinary enlarger, directed at the exposure window, can be used to make the small prints

Handy File for Negatives Has Space for Exposure Data

MINIATURE negatives are kept clean in a compact file that will accommodate 144 films. Besides preserving the negatives, the unit, which consists of twelve transparent pocketlike strips folded accordion-fashion and mounted on a rigid back that may be hung on a wall, allows the amateur to view them conveniently without removing them from their holders. Space is provided for cataloguing each picture with its exposure data.

The picture is flattened by sliding it back and forth under the metal crossbar

Spring-Roller Unit Flattens Prints

PUTTING a reverse twist on a curled photograph to flatten it out, the device pictured above uses a curtain and spring roller resembling a window shade. The photograph is fed under a crossbar and the curtain pulled back and forth until the paper is flat.

Rolling Laboratory Tests Gasoline Sold

Illinois state inspectors taking a sample of gasoline out of a dealer's pump for testing

•

Inside the trailer, the technicians give the fuel the third degree with built-in equipment

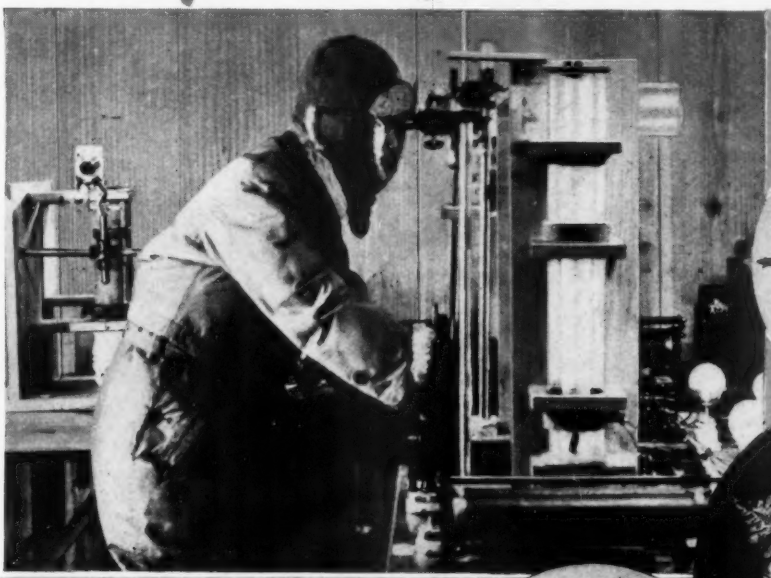
HOUSED in a specially built trailer, a mobile fuel-testing laboratory is now touring Illinois, checking on the quality of gasoline and oil sold at service stations to see that it meets state requirements. Driving up unannounced to a gas station, technicians draw gasoline and oil samples and give them a series of tests with precision instruments permanently mounted within the rolling laboratory. In addition to testing the quality of gas and oil, the touring technicians determine whether gasoline being sold through a pump has been adulterated after it was delivered to the filling station by a distributor.

Dr. R. H. Bullard preparing for a trial of his antigas compound

Spray for Clothing Prevents Gas Burns

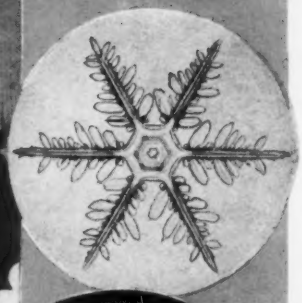
PROTECTION against the severe burns caused by mustard gas, which has been used as a chemical-warfare weapon, is afforded by an amazing neutralizing compound developed by Dr. Ralph H. Bullard, professor of chemistry at Hobart College, Geneva, N. Y. According to college laboratory workers, the new preparation, when sprayed on clothing, will retain its effectiveness for several months. Neither water nor ordinary temperature changes affect the compound, and cleaning does not destroy its effectiveness, it is said.

Snowflakes from the Test Tube



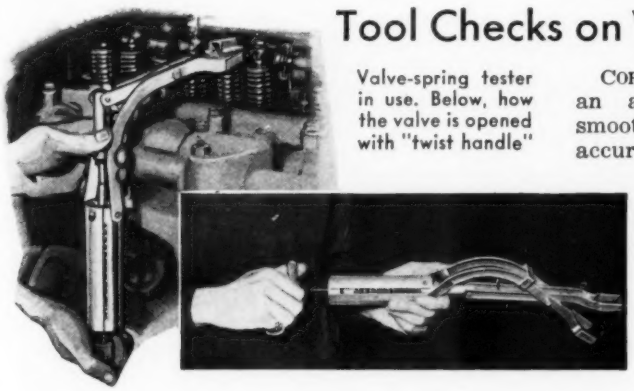
Prof. U. Nakaya making synthetic snowflakes. At right is one of his products; note the hair on which it formed

Below are two of nature's own snowflakes, considerably enlarged



WEARING a fur-lined flying suit for warmth, in his unheated laboratory in northernmost Japan, Prof. Uritiro Nakaya is learning weather secrets by making snowflakes to order. Moist air, sudden chilling, and a small solid object for a nucleus are the three essentials. He obtains the first by heating water with an electric coil. Warm, saturated air rises through a glass chimney into a "cold chamber" where the temperature can be pushed down to sixty degrees below zero F. Instead of the microscopic grains of dust on which snowflakes condense in the sky, he provides a single rabbit hair to make the synthetic snowflake stay put. Pictures taken through the microscope reveal the amazing similarity of his and nature's perishable jewels. By varying the amounts of humidity and chilling, he can imitate at will either the plainer and straighter designs of natural snow crystals, or the fragile beauty of the most lacy and finely branched patterns.

Tool Checks on Valve-Spring Tension

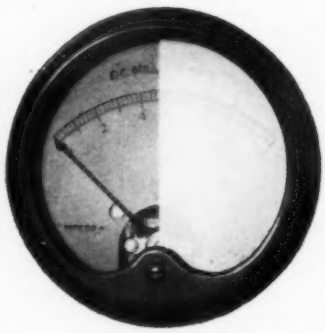


Valve-spring tester in use. Below, how the valve is opened with "twist handle"

CORRECT tension of the valve springs in an automobile engine, important for smooth motor performance, is quickly and accurately checked with a handy new tool. When its two levers are inserted between the bottom of the spring and the tappet guide, or rocker arm, the reading on the scale of a built-in spring gauge shows the pressure of the spring in pounds. A "twist" handle, shown in use at the left, opens the valve just far enough for the test.

Microscopic Film Makes Glass Invisible

Dr. Katharine B. Blodgett treating glass to make it invisible



Meter dial photographed under a strong glare. The left half of the dial glass has been treated with the new process

GLASS that is practically invisible has been produced by Dr. Katharine B. Blodgett, General Electric research expert, by applying to its surface incredibly thin chemical films that cut off reflected light rays. By repeatedly dipping glass into a liquid having a surface chemical film only one molecule thick, a series of minute layers of the chemical is built up on the surface of the glass. Forty-four of these layers, it is stated, form a thickness of only four millionths of an inch. Rays reflected from the various layers of this film neutralize each other so that all reflections and glare are eliminated, practically all the light is transmitted, and the glass itself is invisible. The discovery is expected to revolutionize the manufacture of lenses, display-window panes, clock faces, and other glass products in which reflection detracts from efficiency or beauty.

Novel Cooker Won't Burn Rice

RICE will not stick to the pot and burn, if cooked in a novel kitchen utensil devised by a woman inventor. The rice is placed in a special percolating unit similar to those found in ordinary coffee percolators, which rests on a wire-mesh strainer. When this is suspended from the rim of a pot, boiling water bubbles up through the percolating unit and filters down through the rice, which never comes in contact with the pot itself.

Boiling water bubbles up through the percolating unit to cook rice without burning

New Pipe Holder Has Spring Grip

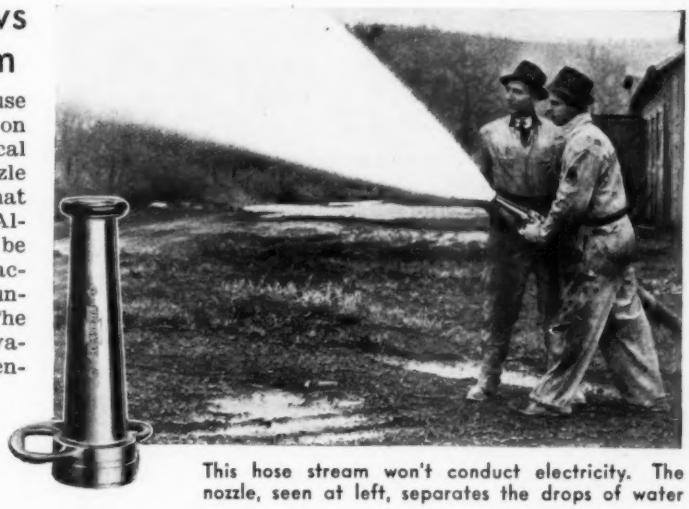
A NOVEL holder that supports a smoker's pipe of any size without marring its finish is made of a flexible, U-shape bronze strip whose ends are fitted with rubber rollers that grip the pipe bowl firmly, as illustrated at the left.

World's Most Sensitive Heat Measurer

CALLED the most delicate heat-measuring device in existence, a calorimeter now in use by chemical experimenters at Northwestern University, Evanston, Ill., is so sensitive that it can accurately measure the amount of heat produced when a lump of sugar is dissolved in water. Designed for research work on proteins in diet, the instrument will record on paper changes in temperature as minute as one millionth of a degree.

Hose Nozzle Throws Shockproof Stream

DEVELOPED primarily for use where water will be directed on or near live wires or electrical apparatus, a new fire-hose nozzle projects a stream of water that will not conduct electricity. Although the stream appears to be exactly like any other, it is actually made up of individual, unconnected drops of water. The separation of the particles of water constituting the stream renders it nonconductive to electric current. A close-up of the new nozzle is shown at the right, and it is seen in use in the larger picture.



This hose stream won't conduct electricity. The nozzle, seen at left, separates the drops of water

POPULAR SCIENCE Question Bee

Fact and foolishness are carefully blended in the numbered paragraphs below. Try to pick out the correct statement in each case. Note your choices and check them against the list on page 236

1 A magnifying glass makes things look bigger by *(a)* halation *(b)* refraction *(c)* dispersion *(d)* accommodation *(e)* irradiation *(f)* filtration.

2 You use your bicuspids in *(a)* walking *(b)* chewing *(c)* throwing a ball *(d)* seeing in the dark.

3 Polygons have many *(a)* legs *(b)* wheels *(c)* angles *(d)* wives *(e)* syllables.

4 Electric motors use *(a)* carbon brushes *(b)* wire brushes *(c)* air brushes *(d)* camel's-hair brushes.

5 Beryllium is *(a)* an ornamental flowering shrub *(b)* a size of printer's type between agate and minion *(c)* a metal lighter than aluminum *(d)* a star that guides navigators in the Southern Hemisphere.

6 A house with exterior walls of masonry, interlaced with visible wooden beams, is called *(a)* jerry-built *(b)* full-fashioned *(c)* half-timbered *(d)* jury-rigged.

7 Your spinal cord joins the part of your brain called the *(a)* alter ego *(b)* modus operandi *(c)* ignis fatuus *(d)* medulla oblongata.

8 At the opposite end of the color spectrum from the ultra-violet lies the *(a)* chrome yellow *(b)* infra-red *(c)* electric blue *(d)* visual purple.

9 A socket wrench would be useful for *(a)* replacing burned-out lamp bulbs *(b)* attaching a camera to a tripod *(c)* tightening hexagon nuts *(d)* opening a window that sticks.

10 Guantanamo is *(a)* a Central American republic bordering Mexico *(b)* a type of fertilizer harvested on islands frequented by sea birds *(c)* an important United States naval base in Cuba.

11 Cartographers make *(a)* wagons *(b)* cartoons *(c)* crop forecasts *(d)* maps *(e)* player-piano rolls.

12 You could buy perique from a dealer in *(a)* photographic chemicals *(b)* smoking tobaccos *(c)* plumbing supplies *(d)* fireworks.

13 Protractors are *(a)* the opposite kind of snakes from constrictors *(b)* vehicles that run on endless treads *(c)* drafting instruments for laying out angles *(d)* persons who work for contractors.

14 Two chemical elements are liquids at ordinary temperatures—mercury and *(a)* bromine *(b)* hydrogen *(c)* iodine *(d)* vanadium.

15 "Cassegrainian" is a name applied to an important type of *(a)* coast-defense gun *(b)* steam turbine *(c)* astronomical telescope *(d)* barometer.

16 Spinnerets are *(a)* what spiders make webs with *(b)* old-fashioned pianos *(c)* large triangular sails used by yachts in running before the wind *(d)* the picturesque towers of mosques.

17 Kaolin is used to make *(a)* artificial silk *(b)* soldering flux *(c)* porcelain *(d)* purple dyes.

18 The compression of an automobile motor can be employed as a *(a)* self-starter *(b)* brake *(c)* shock absorber.

19 In some maps, points of equal elevation are connected with *(a)* Fraunhofer lines *(b)* plumb lines *(c)* contour lines *(d)* agonic lines.

20 A tapir is *(a)* a small wax candle *(b)* an instrument for measuring gear teeth *(c)* an Arabian chieftain or ruler *(d)* an animal related to the horse and rhinoceros.

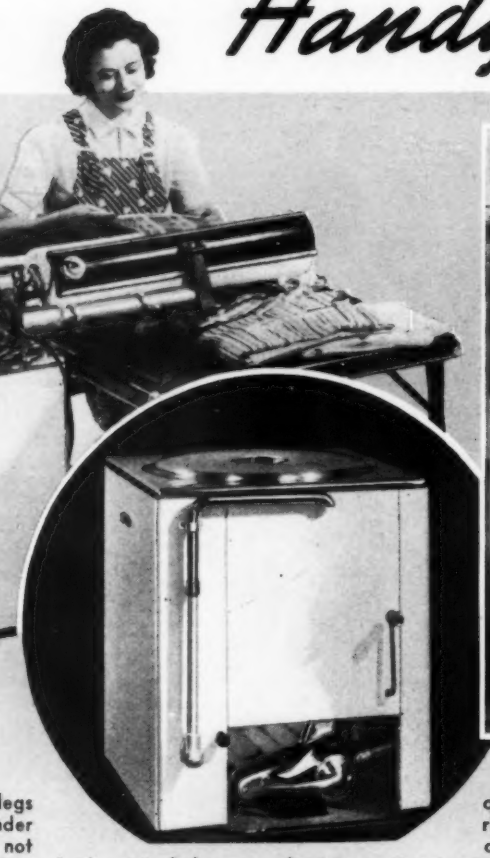
Un-Natural History

By Gus Mager

I CAN'T BELIEVE MY EYES, DOCTOR!
SCIENTISTS HAVE JUST DISCOVERED THAT THE **PORPOISE** DOES NOT SLEEP WITH ITS EYES OPEN, AS FISH DO! HOWEVER, THE PORPOISE IS NO FISH, ANYWAY, BUT A MAMMAL, LIKE THE WHALE!
Z-Z-Z-

Handy Aids

COMPACT LAUNDRY
This kitchen unit will even wash blankets and iron shirts and sheets



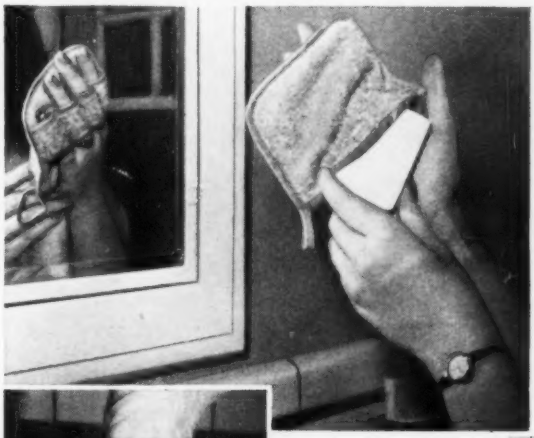
Mounted on retractable legs so that it can be kept under the kitchen sink when not in use, the machine pictured above includes a washer, wringer, drain pump, and ironer, all operated by the same motor. Self-contained, it requires no separate wash or rinse tubs, and no plumbing connections are needed. The aluminum wringer, seen in operation above, is easily detached and stored in a compartment in the rear of the cabinet, as illustrated at left

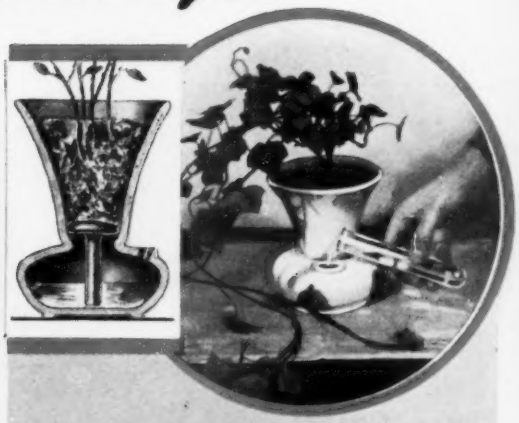
STRAINER SAUCEPAN
With its cover locked on, the pan at the right can be tipped safely to drain off boiling water. Strainer holes may be closed for cooking

MIXING-BOWL CLAMPS
To hold a mixing bowl steady while in use, spring clamps like the one illustrated below are hooked between the bowl lip and the table edge

for the Housewife

SOAP MITT. Soap holder and wash cloth are combined in the mitt seen below. The cloth pocket has loops on the back, in which the fingers are inserted

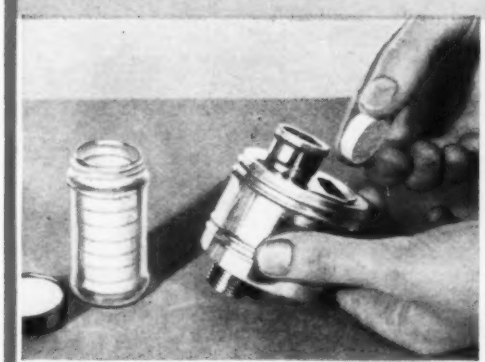




SELF-WATERING FLOWERPOT. Water placed in the bottom part of this ingenious pot is fed to the plant roots through a wick made of a special porous burnt clay, as illustrated in the drawing

NEW CAN OPENER
A vacuum cup on this can opener grips the top of the can. When the lid has been cut out by squeezing the grip and turning the crank, it is lifted out easily and safely

PERFUME SHOWER ATTACHMENT. In the latest type of shower head for scenting bath water, a tablet inserted in a slot, as shown, provides enough perfume for one shower



LATHELIKE POTATO PEELER. Geared to an electric mixer, the device above rotates a potato while a moving blade removes the peel. It will also peel apples

One of the fellows yelled: "Holy Mackerel! The gas tank's gone!"

GUS GIVES THE LOW-DOWN ON

VARNISH - A New Engine Trouble

GUS WILSON started it by remarking that the bass season would open the next morning, and that he was going up to the lake to have a try try at those old bronze-backs.

That started off George Knowles, whose number-one conversational favorite is fishing. "I just got back from a fishing trip up in Maine," he told the little group of Gus's customers and friends who had drifted into the shop of the Model Garage for the laudable purpose of killing a late-afternoon hour. "Did I tell you about the—"

"Yes, you did!" the group chorused. They had heard plenty about George's fishing adventures since he got back home.

Knowles grinned at them. "All right," he conceded, "I won't make you sunfish catchers jealous by telling you about the twelve-pound landlocked salmon that it took me forty minutes to get into the boat. . . . This is something different. I've been saving it for Gus—it's about a queer experience I had with my car.

"One day while I was up there in Maine, a couple of other fellows and I took a trip to a little lake 'way back in the woods. We fished all day, and didn't have any luck at all. Then, just about sunset, they started biting. Oh, boy! Result was that it was after dark when we got ashore, and about nine o'clock by the time we'd finished supper at the guide's house and got started for the hotel in my car. We had a thirty-five-mile drive ahead of us—fifteen miles of it over as rough a woods road as I've ever seen.

"We hadn't gone far when it started to rain. But we bumped along all right for maybe a half hour. Then we blew out a tire. While we were changing it one of the fellows let out a yell: 'Holy Mackerel! The gas tank's gone!' And it *was* gone—jarred right off the car!

"That *was* sweet. We walked back half a mile looking for it—I had a flash light, of course—but we couldn't find it. Then the flash light began to go dim, so we went back to the car.

"We sat there for a while, wondering what the devil we should do. I remembered that where we'd turned off from the main highway there was a settlement, and I'd noticed a gas pump in front of a little hick garage. We figured that we couldn't be very far from that place—that maybe we were close enough to it for the gas left in the vacuum tank to take us there. If it didn't—well, we wouldn't be any worse off than we were. So we started.

"Just as we got over the crest of a low hill, a little way along the road, I saw dim lights down in the dip ahead, and just then the engine coughed and quit. But I let the car coast down the hill, and we just made it to the little garage I'd noticed that morning—our headlights picked up its gas pump at the side of the road. The place was dark, but after we had hammered on the door for a while an upstairs window was opened, and a woman stuck out her head and said she'd be down in a minute. When she came down she said that her husband, who ran the garage, had gone to Portland and wouldn't be back for a couple of days. She knew how to work the gas pump, but that's all she did know. Naturally, she couldn't be any help to us in replacing our lost gas tank.

"There didn't seem to be anything to do but stay where we were until morning. The woman told us that the proprietor of the little general store across the road let rooms to tourists. When we got over there, he was locking up for the night, but he let us in. I noticed that he had a display of oil cans in his window, and they gave me an idea.

"'I want to buy a five-gallon oil can and a three-foot length of rubber hose,' I told him. While he was getting them for me, I said to the other fellows: 'Don't bother about rooms. We won't need them. I'll get you back to the hotel tonight.' They looked as if they thought I was screwy, but they didn't say anything, and went back to the car with me.

A Customer Brings a "Sticker" to the Model Garage, but Gus Wilson, Master Mechanic, Solves It

By

MARTIN BUNN

"After some more pounding on the garage door, I got the woman to come down and fill the oil can with gasoline. Then I got into the car and worked the free end of the gasoline feed pipe up through a hole in one of the floor boards. Next, I connected one end of the length of rubber hose I'd bought to the pipe, and dropped the other end into the can of gasoline. The engine wouldn't start until I'd poured some gasoline into the empty vacuum tank, but after that we rolled right back to the hotel. Pretty good, hey? That was the queerest case of car trouble I've ever had."

Young Jack Simpson, looking disgusted, had come in while his father-in-law was talking. "You call that queer—and you call it trouble!" he said. "I've got some queerer trouble that's a whole lot worse, and I didn't have to go away up to the Maine woods to get it. It's parked right down in front of our house."

He turned to Gus Wilson. "It's that new bus of mine, Gus. I've got about twenty-five hundred on the clock, and I've never had a bit of trouble until now."

"What's the trouble now?" Gus wanted to know.

"You can search me," Simpson said. "The engine just won't turn over, that's all. I drove down to the city this morning, and coming back everything was jake. I stopped at the house, just to leave some stuff that Alice asked me to buy, and as I didn't expect to be more than a minute I left the engine idling. But Alice and I started talking, so I was longer than I'd thought I'd be—maybe seven or eight minutes.

"When I got into the car I noticed that the engine had stopped. I didn't think anything of that, until I stepped on the starter and nothing happened. I tried everything I knew, but I couldn't get a single kick out of the engine—couldn't get it to turn over. The starter seemed to be all right, but it was like—like kicking at the Washington Monument!

"After I'd been fooling around for a half hour, George Nelson came along in that '31 coupe of his. He happened to have a piece of old rope in the rumble, and said that maybe I could get started if he towed me a way and then I let in the clutch. We tried it, but that darned engine felt as if it was frozen solid. Soon as I eased in the clutch, the rope broke. So we pushed the car back to the curb, and I left it there. That was an hour ago. I had to do some errands on the

way out here. What had I better do, Gus? That engine sure is a sticker!"

"A sticker," Gus repeated thoughtfully. "I think maybe you've got something there, Jack. Well, first thing to do is get your car up here to the shop where we can work on it."

Simpson nodded agreement, and handed over his keys. "Hey, Speedball!" Gus said to Harry, the grease monkey, who had been listening in on the conversation. "Take the wrecker down to Mr. Simpson's house and tow his car back here, will you? Here are the keys, but as the engine won't start you probably won't need them."

FIFTEEN minutes later a horn tooted outside the door and Gus and Jack Simpson looked up to see Harry drive Simpson's car into the shop.

He got out, grinning widely. "When I got there," he explained, "I thought I'd give the starter a kick, just for luck. Darned if she didn't buzz off without a struggle, and she ran all right all the way back here, except that she's a little stiff. Now I'll ride down on my motor bike, and bring back the wrecker."

Gus looked after him, and shook his head. "What a brain!" he said. "That kid's a real genius at making two trips when one would do. Never misses on it!"

"Huh?" grunted Simpson, who was staring at his car. "Oh, yes—good excuse to get a little ride on that motor cycle of his. Say, Gus, I feel like a fool! I don't know much about cars, but I'll swear that an hour ago that engine just wouldn't start!"

"Of course it wouldn't," Gus agreed. "And it wouldn't have started for Harry, or for me, or for anyone else, any more than it would for you."

He got into the car, and ran the engine at varying speeds for a minute. Then he got out, and raised the hood.

"The first thing to do," he decided, "is to get the cylinder head off. I'll tell you what we'll find, if the trouble is what I think it is. We'll find the pistons and piston rings and maybe the valves covered with a brown stain that looks and feels like varnish. Now, let's see how near I've come to guessing right."

When the cylinder head was off, there wasn't the slightest doubt that Gus had guessed right—again. The pistons and all the other smooth internal surfaces of the engine that were visible were covered with an amber-colored stain. So were the valves and tappets. "What the deuce is it?" Simpson demanded, poking a valve with his forefinger, and finding the brown stain slightly sticky.

"Well," Gus told him, "we used to call it burnt oil. Now, automotive engineers usually call it 'varnish.' To tell the truth, I don't think anyone knows exactly what it is—yet. Until recently, they didn't even know what caused it. Some said that it came from the gasoline, and others said that it came from the lubricating oil. But, not long ago, the research men of one of the big manufacturers took a lot of photographs of the pistons of engines which had been run on the same fuel, but with different lubricants. Some of the pistons were clean, and some of them were coated with varnish, which proves that the varnish is formed by the lubricating oil, and not by the fuel. But just how and why the varnish forms is something that even the chemists are still hazy about. They say that it is a synthetic resinous compound produced by little-known chemical reactions—a sort of oxidation of oil at high temperatures. . . Whatever it is, it can raise hob with a gas engine!"

"What will take it off?" Simpson wanted to know.

"I've tried a lot of things, at one time and another," Gus told him. "I know what *won't* take it off. It is insoluble in mineral oil, gasoline, kerosene, turpentine, or water. It is more or less soluble in alcohol, carbon tetrachloride, lacquer thinner, and caustics. I'm afraid we're going to have quite a job, Jack. I'll have to take your engine pretty well apart, and do some experimenting to see what works best in getting the danged stuff off. If we leave it on, you'll have a lot more trouble."

"All right, Gus. Do whatever you think is best," Simpson said. "But I still can't see why the engine *(Continued on page 242)*

"What the deuce is it?" Simpson demanded, poking a valve with his forefinger and finding the brown stain slightly sticky

THE HOME WORKSHOP

In This Issue... GARDEN CARPENTRY • AIDS IN AMATEUR PHOTOGRAPHY
BOAT PAINTING • MODEL FIGHTING PLANE • LATHE UPKEEP

DESIGNS TO SUIT EVERY TASTE IN Decorative

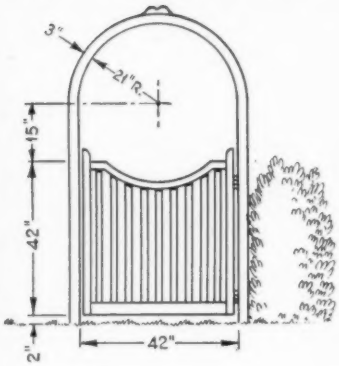
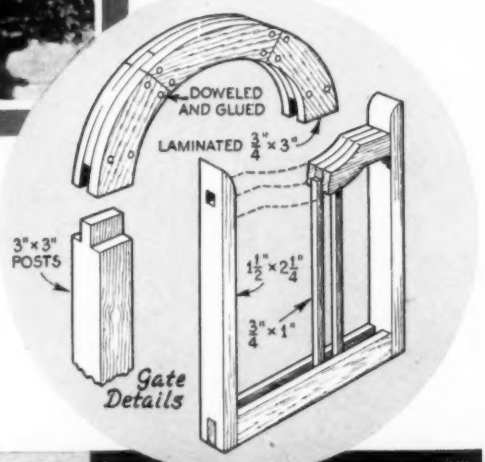


Fig. 1. A graceful, easily made arched gateway at Carmel-by-the-Sea, Calif. Right, the drawings



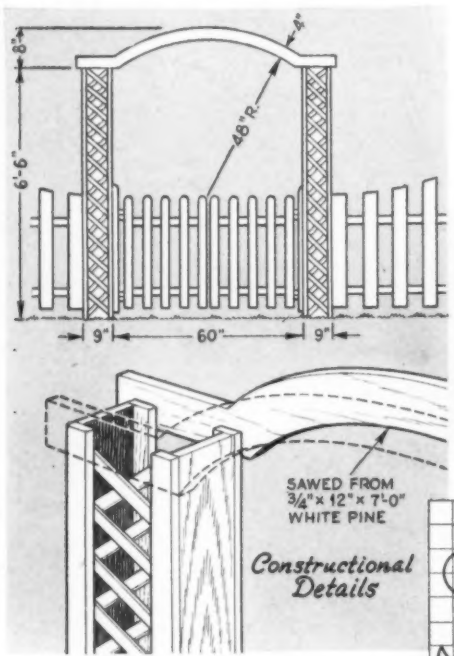
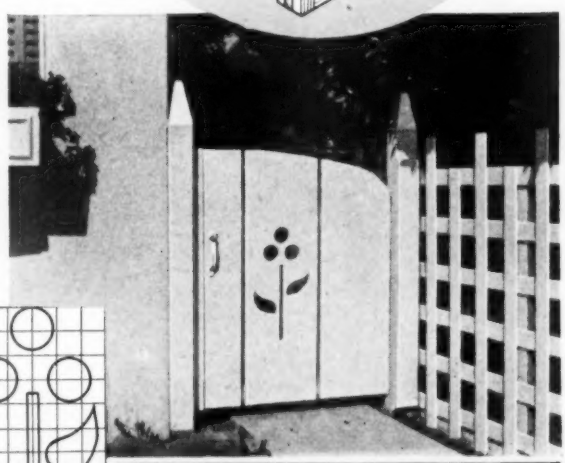


Fig. 3. Another type of arched gateway that serves also as a trellis. It can be narrowed for a single gate, if desired



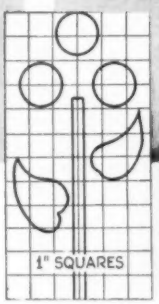


Fig. 2. A little imagination goes a long way in designing a gate. Here is a type that may be varied in countless ways. Any suitable pattern may be cut out to ornament the wide central plank

Garden Carpentry

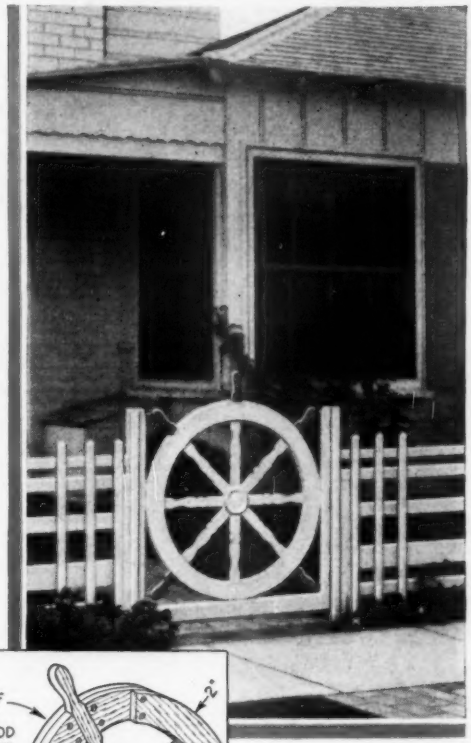
FIFTEEN SUGGESTIONS FOR BUILDING FENCES, GATES, TRELLISES, SEATS, AND SMALL SUMMER HOUSES

By HI SIBLEY

ATTRACTIVE fences, trellises, gates, seats, and summer houses will vastly improve otherwise uninteresting gardens. Many decorative and distinctive designs are shown in the accompanying illustrations, and these can be made by the home owner at a comparatively small outlay for materials.

Since garden carpentry should be designed to suit the particular setting in which it is to be placed, considerable latitude may be allowed in modifying dimensions and in combining elements of one design with those of another. White pine is usually the preferred material, because it is durable, easily worked, and takes paint well; but other woods such as cypress, redwood, chestnut, spruce, and fir are often used.

The arched gateway, Fig. 1, fits harmoniously into any landscaping scheme, and as can be seen from the drawings, the construction is quite simple. In making the laminated arch, use casein glue between the pieces and take care that



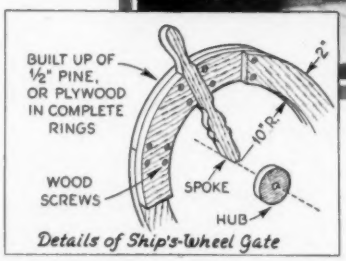
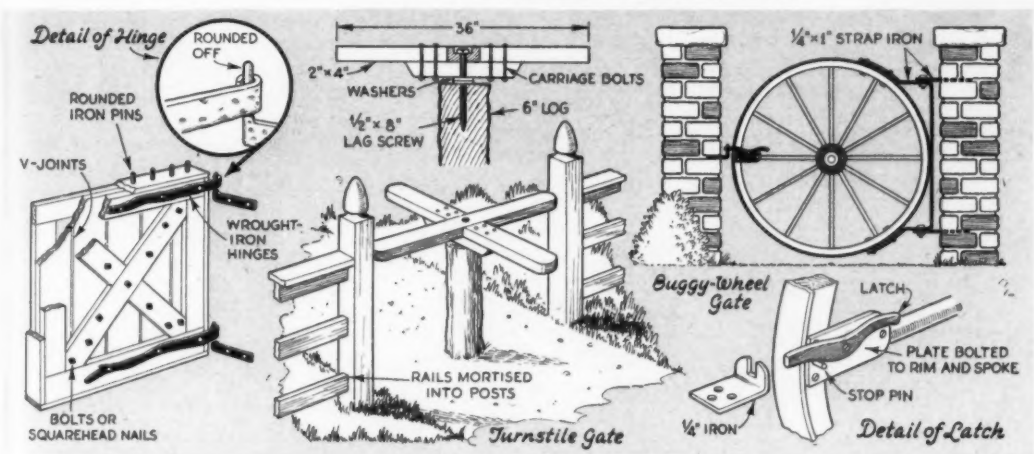


Fig. 4. Pilot-wheel gates are especially suitable for beach or lake homes. Note the unusual picket fence



Figs. 5, 6, and 7. The gate at the left is for use in a brick or tight board fence. The second is a picturesque turnstile. The third is made by adding hinges and a catch to an old buggy wheel

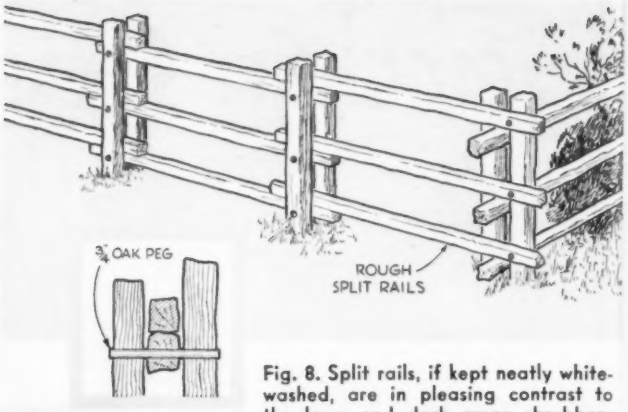


Fig. 8. Split rails, if kept neatly whitewashed, are in pleasing contrast to the lawn and dark green shrubbery

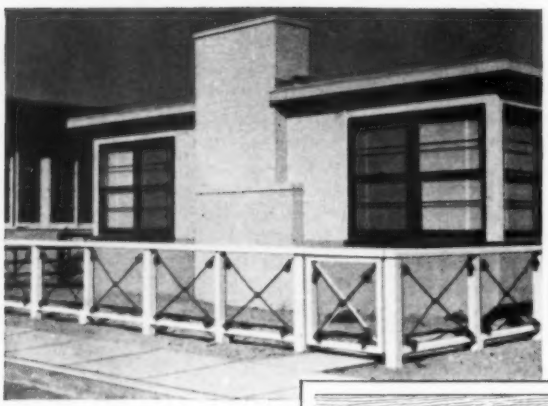
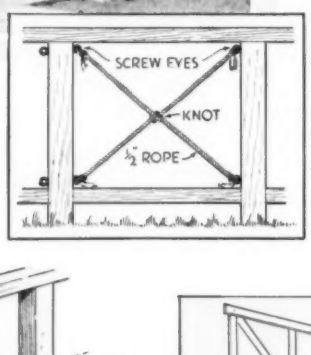


Fig. 9. Crossed ropes are used ingeniously to fill the panels of this novel fence, which was designed for use at a modern seashore home



the dowels fit snugly. If this is done, the edges can be planed and sandpapered to give the appearance of one solid arch, especially when painted. Bear in mind that in any outdoor woodwork it is better to avoid nails and use only screws (galvanized at that) or dowels. Then, after a few seasons of rain, snow, hail, wind, and sun, the gate or other structure won't be falling apart or warping out of its original shape.

Several adaptations may be made of the cut-out gate in Fig. 2. The essential requirement is a central board wide enough to carry the design.

In Fig. 3 is another style of arched gateway, this one serving as a trellis as well. This design is intended for a double gate, but the width can be reduced to 3′ for a

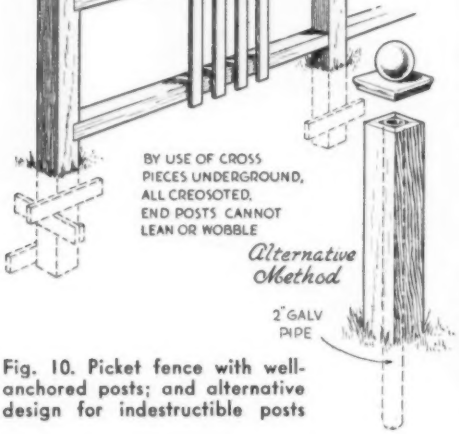


Fig. 10. Picket fence with well-anchored posts; and alternative design for indestructible posts

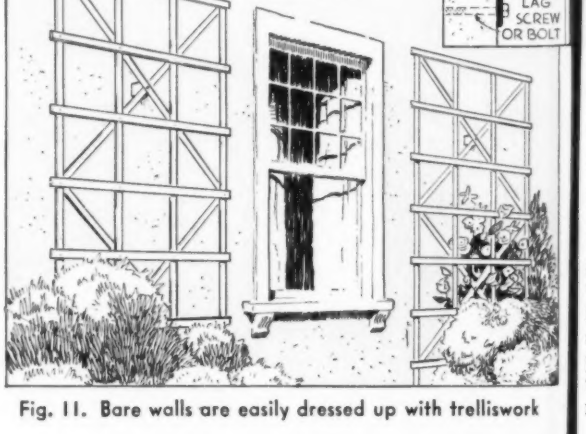
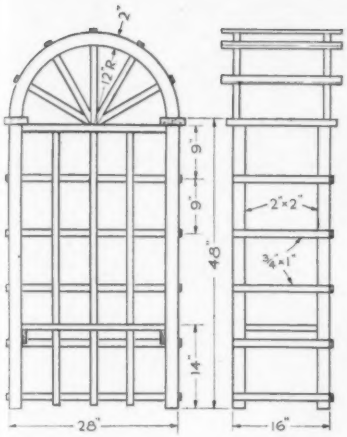


Fig. 11. Bare walls are easily dressed up with trelliswork



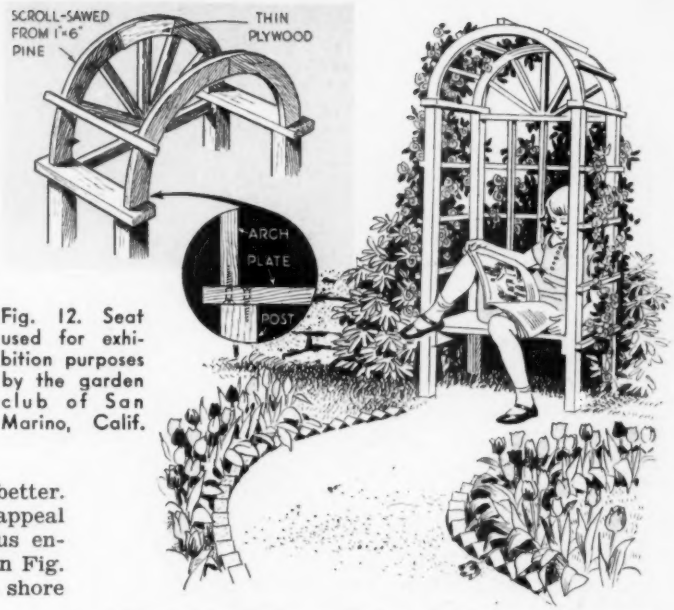


Fig. 12. Seat used for exhibition purposes by the garden club of San Marino, Calif.

single one if it fits the garden better.

Pilot wheels have a decided appeal for decorative purposes in various environments, and the gate shown in Fig. 4 is quite at home in front of a shore cottage.

For privacy and in conjunction with a solid brick wall or tight board fence, a substantial gate such as in Fig. 5 is in order. It can be carried up to shoulder height, or just enough to keep the neighbor's dog out or your own in, and the harmless row of iron pins on top definitely says "Keep out!"

Purely picturesque rather than utilitarian is the turnstile in Fig. 6. Originally this type of gate was intended to keep out wandering livestock.

Buggy wheels are highly popular as lawn ornaments, superseding the iron deer of an earlier generation. In Fig. 7 is a satisfactory way to hang one for use as a gate.

If split rails are available, an extremely picturesque fence can be made as in Fig. 8. This arrangement has become so popular that even city homes have them, though unquestionably it is a style for suburb or country.

Several methods of using rope in fences and porch rails are possible. Figure 9 shows one of them.

That old favorite, the familiar picket fence, Fig. 10, is easily built. The end posts can be prevented from leaning or wabbling by nailing crosspieces to the lower end, as shown. All wood below grade should be creosoted or painted with an asphaltum or tar product. An indestructible or nondecaying post is also illustrated. It is simply an iron pipe with a wood "shirt," mitered at the corners, built around it and surmounted with a cap. Incidentally, a

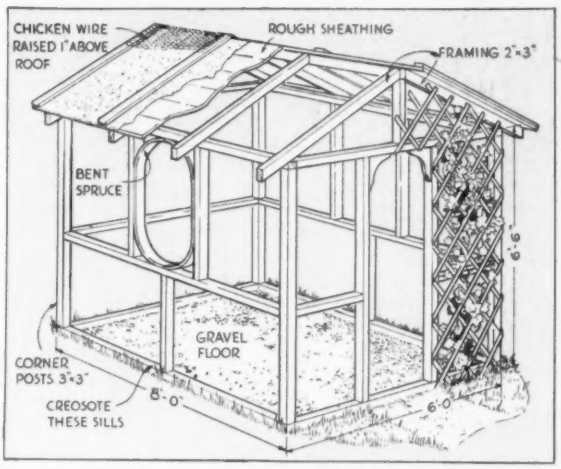
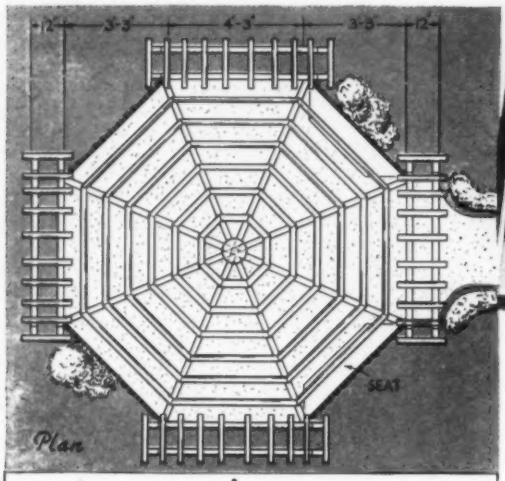
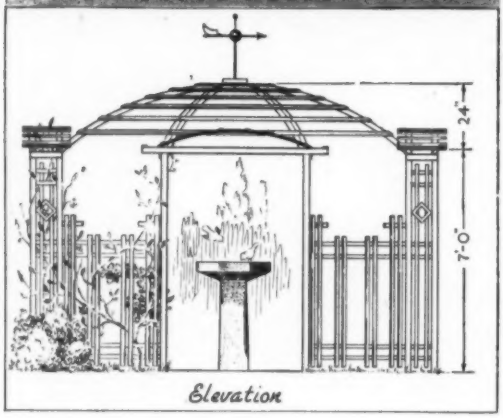
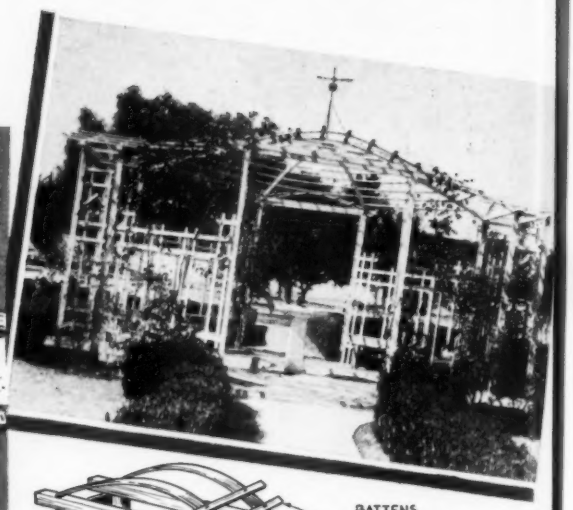


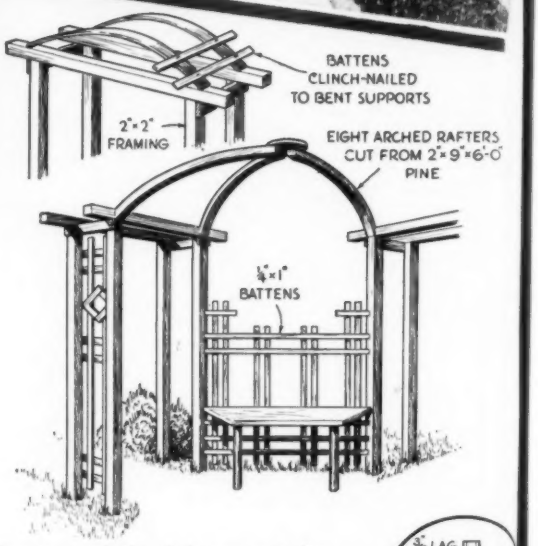
Fig. 13. An inexpensive summer house. Gourds hang as ornaments in the vines

Fig. 14. A graceful trelliswork summer house with bird bath in Mrs. George W. Ackermann's garden, San Gabriel, Calif.









Drawings of the Ackermann trellis. Four garden walks meet beneath it

discarded croquet ball can be screwed to a board to form this type of cap.

Bare walls can be improved with trellises similar to those shown in Fig. 11. To permit vines to climb freely, these should be supported an inch or two away from the wall.

A garden seat is a real asset, and in Fig. 12 is shown one exhibited by the San Marino, Calif., garden club. It has been selected for reproduction because of its simple and pleasing design.

For a cool summer house, a simple frame of rough lumber covered with crossed slats can be built at small cost, as in Fig. 13.

A more elaborate and unusually graceful design is given in Fig. 14. In this case the summer house is set in a semiformal garden, with four walks meeting under it and a bird bath at the center.

The conventional but always attractive design in Fig. 15 can be built smaller than given here, or expanded.

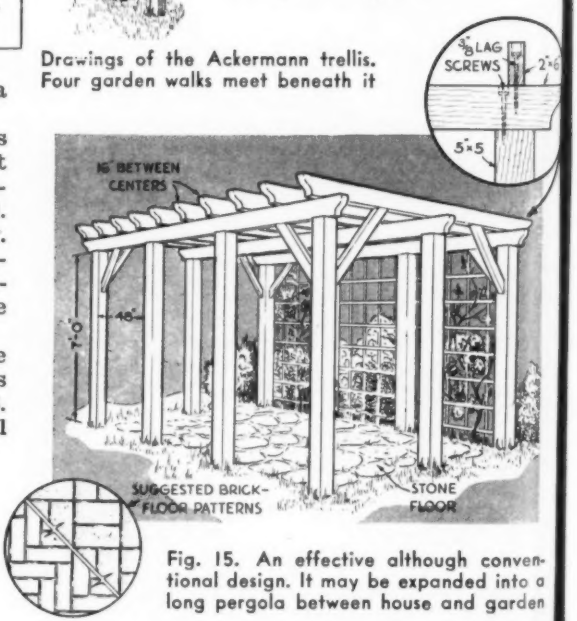
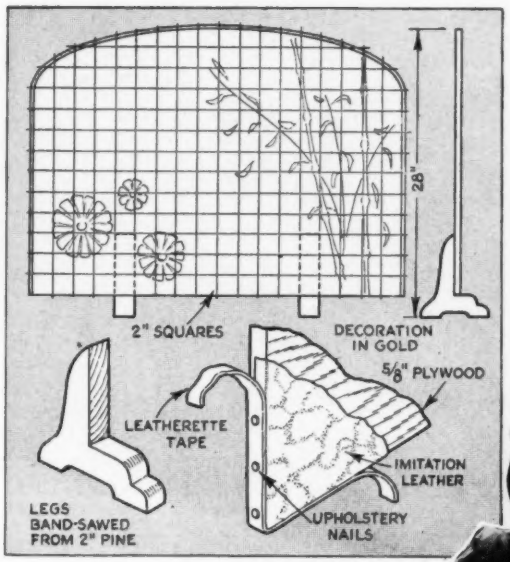


Fig. 15. An effective although conventional design. It may be expanded into a long pergola between house and garden



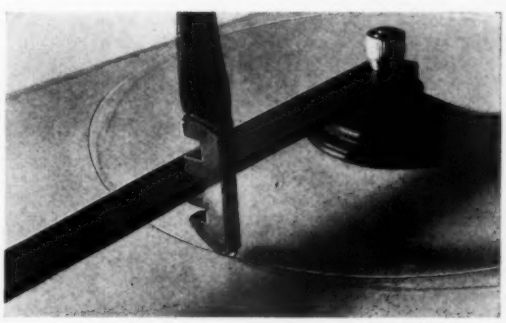
Screen for Fireplace Covered with Leatherette

THE dark, cavernous maw of an unused fireplace is hardly a thing of beauty during the warm months, but it can be effectively and pleasingly screened as shown. The screen is simply a panel of plywood with a curved top mounted on two feet and covered on the exposed side with imitation leather, which is fastened along the edges with leatherette binding tape and upholstery nails. The decorations are done in gold or aluminum, and the entire surface then varnished or shellacked.—LOWELL R. BROWNE.

Rubber Tubing Improves Spring Filing Clip

WHEN carbon copies must be made of a form held on a paper filing board, the tendency of the spring clip to cause a smudge can be greatly reduced by gluing a small, slitted rubber tube to the steel edge. Windshield-wiper tubing is fine for this purpose.

The tubing glued to the clip forms a greater area of contact and prevents the carbon from smudging



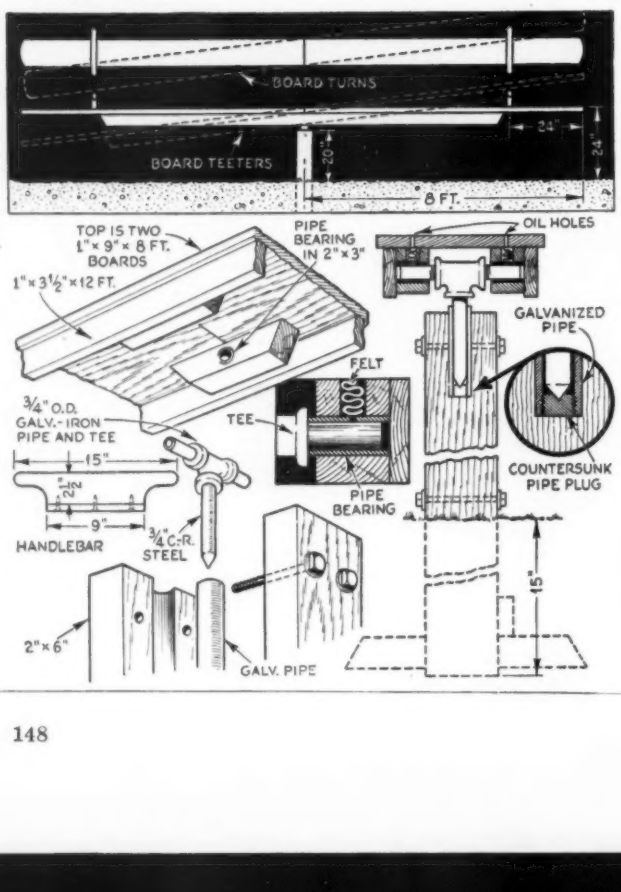
Circular Jig Quickly Cuts Disks from Sheet Glass

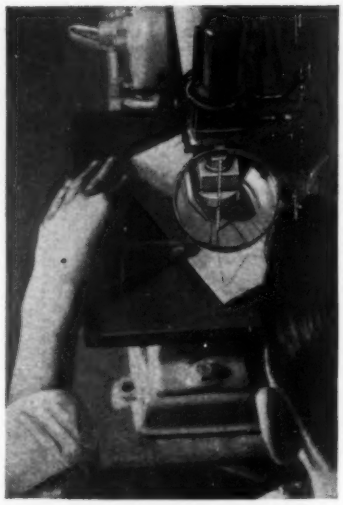
CIRCLES can be cut accurately from glass with this simple jig. Make the arm from 3/16" pressed composition wood, tempered quality, and sand it down slightly so the cutter will be held in place by friction. Drill a close-fitting hole at one end for attaching the suction cup. To remove each disk from the sheet, make radiating cuts from the circle to the edge of the glass, then break off the waste one piece at a time.—E. A. BOWER.

Merry-Go-Teeter for Playground Contains Self-Oiling Device

MERRY-GO-ROUND and seesaw are combined in this novel playground device. Note that the chassis is made of two 8′ boards and that the supporting members permit 1″ thick material to be used. The short piece of ¾″ cold-rolled steel turns in a section of pipe set in the supporting post; a plug in the bottom of this pipe is countersunk to receive the pointed steel bar, and oil is poured in for permanent lubrication. To lubricate the horizontal axis, ½″ holes are bored vertically into the wooden members and packed with felt.—D.H.

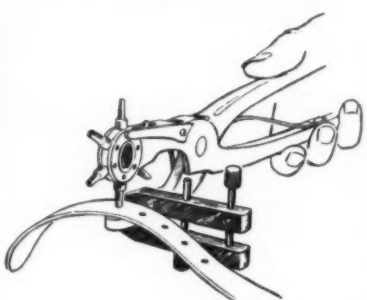
The device runs silently and easily and will remain in good repair for an indefinite period. Below, complete drawings





Reading Glass Aids Work on Jig Saw

FINE jig-saw work may be done more easily if a large reading glass is attached to the machine. A convenient way to fasten the glass is by means of a small clamp to which the threads of the glass frame are fitted. It can then be readily removed to make adjustments. The glass also acts as a shield from broken blades.—D. R. F.



Guide Fence Applied to Leather Punch

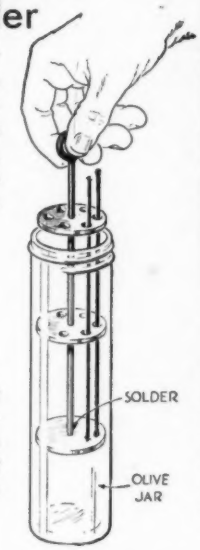
A SMALL steel parallel clamp, if attached to the anvil jaw of a leather punch as illustrated above, will provide a handy guide for the accurate alignment of a series of holes in a strap or any other piece of leatherwork. Attach the clamp so that it does not interfere with the punch jaws.

How to Fasten Vines to Brick or Stucco

WHEN climbing vines have to be fastened to stucco or brick walls, the usual method is to drive nails or special hooks into the wall. A quicker and more harmless method is to fasten short pieces of string across the stem of the vine with plastic composition wood. A small pellet of this material is pressed on the string and forced into contact with the wall.—A. J. VIKEN.

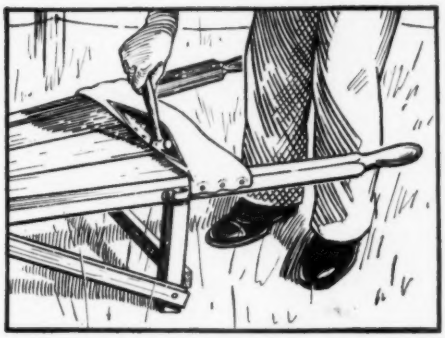
Jig-Saw Blades Stored in Rustproof Holder

A RUSTPROOF holder for jig-saw blades can be made from a large olive jar. Three metal disks are cut to fit, and the necessary holes are drilled. The central rod, shaped from a piece of heavy wire such as is used for coat hangers, is then soldered to the disks.—S. J. G.



Citronella Oil in Paint Keeps Insects Off

FRESHLY painted surfaces are sometimes marred because countless small insects stick to them. This can usually be prevented by adding about ¼ oz. oil of citronella to each gallon of paint.—K. F. K.

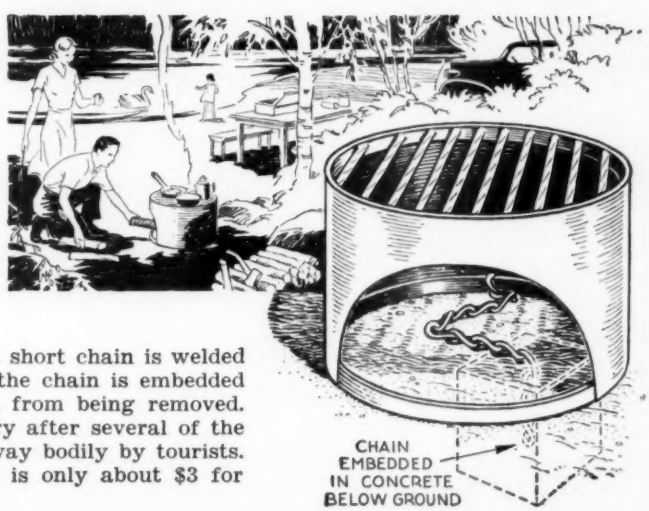


Tool Holder for Barrow

SMALL tools may be carried more readily on a wheelbarrow if a portion of an old inner tube is nailed across the handles, behind the platform, as shown above. The tube is slit on the inside so the tools may be placed in it to keep them from falling out.

Durable Picnic Fireplaces Made of Welded Steel

FIREPLACES at public picnic grounds and trailer parks are difficult to keep in repair, and the iron grate bars are often taken away for use as tent stakes or other purposes. To prevent this, one Wisconsin summer-resort owner uses all-metal fireplaces welded together as shown. The body is of 12-gauge steel reënforced with a 1″ by ¼″ bar at the top and another at the bottom. The grate bars are ⅜″ concrete reënforcing bars bought at low cost from a road contractor. A short chain is welded to each unit, and the other end of the chain is embedded in concrete to keep the entire unit from being removed. This precaution was found necessary after several of the first fireplaces made were taken away bodily by tourists. The entire cost, including welding, is only about $3 for each fireplace.—K. N. BANTHIN.



How to Keep Your

By RALPH G. WARING

EVEN to the average boat owner the problems of boat painting are many, but to the practically minded paint technician the whole subject is one vast headache. None knows better than he the extreme complexity of painting hulls to keep them in good condition in fresh or salt water, or both. Among the difficulties are marine growths and boring insects; blistering sun and freezing cold; good materials applied over bad; careless beaching and docking; the failure to wash down with fresh water after each salt-water run; the destructive influence of sulphide waters in harbors foul with sewage; and failure to clean and wash hulls and decks properly before laying up a boat.

The worst trouble of all, however, may be traced to one fundamental lack—the failure to *allow thorough and complete drying of each coat of material before applying the next.* Thorough cleaning, sanding, and preparation, followed by hard drying of high-grade, properly chosen materials are essential for creditable marine painting.

Here are the most important precautions to observe:

1. Choose paints recommended by a reputable firm. 2. Use the products of only one manufacturer on any one job. 3. Avoid using soft-drying coats over hard and *vice-versa.* 4. Never paint over a wet surface or wood containing free moisture. 5. Be sure all surfaces are clean. 6. Work in a warm place, free of direct sun, wind, or dust. 7. Prime all new work properly and dry hard before using cement or putty glazing. 8. Make certain that all paint is well stirred and

HARD-DRYING PRIMER COAT FOR BOAT HULLS [PAINTING]

Red-lead paste	4 lb.	Quick-drying marine spar varnish	1 qt.
White-lead paste	6 lb.	Pure turpentine	1½ qt.
Zinc-oxide paste	2 lb.	Turpentine Japan dryer	2 oz.

This is for use on mahogany, redwood, white cedar, white pine, or cypress below the gunwales. Brush on and work out well to avoid a heavy coating. Dry as long as possible in a warm room before recoating with a suitable bottom paint. Do not use as an exposed coating or over anti-fouling bottom paints applied the previous season.

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Boat Well Painted

A marine type of hard racing enamel is used for the finishing coats on canvas-covered canoes and boats

strained. 9. Get good brushes and keep each color separate. Suspend each brush in pure turpentine between jobs. Do not stand brushes on their bristles. 10. Brush out all coats carefully. 11. Dry each coat hard.

Specifications will now be given for various types of new boats. Obviously, in repainting a boat, some of the operations may be omitted and the number of coats reduced.

Rowboats. If white oak framed and cedar

MARINE-TYPE SILEX FILLER FOR BOATS [*PAINTING*]

Boiled linseed oil	4 oz.	Pure turpentine	4 oz.
Quick-drying marine spar varnish	10 oz.	Silex	5 lb.
Turpentine Japan dryer	4 oz.		

Mix to a stiff dough and reduce to working consistency with a thinner consisting of 1½ qt. turpentine to 2½ qt. gasoline.

To fill and seal cypress, white cedar, redwood, or white pine before coating with quick-drying marine spar varnish, use from 5 to 7 lb. filler per gallon of thinner. For oak or mahogany hulls, trim, decks, etc., use 12 lb. per gallon. For Philippine mahogany (red or white lauan) use from 16 to 18 lb. per gallon, colored to match with colors ground in oil. The mahoganies may need double filling; allow 48 hours between coats.

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planked, with transoms, seats, coamings, and deck of mahogany, they should be finished natural throughout with four coats of marine spar varnish, quick-drying type. If of white pine, redwood, or white cedar:

1. Sand clean and smooth, rounding off all edges to a ⅛" radius. 2. Prime with marine-type red-lead primer. Dry hard, sand smooth. 3. Knife on bottom-type seam cement and let dry. Prime and dry. Sand lightly. 4. Apply coat of antifouling bottom paint to entire outside hull. Do not sand this type of soft bottom paint. 5. Brush or spray two or three coats of bottom paint, antifouling type, to entire outside hull. Do not sand between coats. Give all possible time between coats; two weeks in a warm room is not too much for each coat. Let dry as long as possible before using boat in water. 6. Use deck paint of suitable color for inside faces of boat hull and bottom slat frame. 7. Seats may be finished natural if desired.

Canoes and small boats with canvas-covered hulls. 1. Two brush coats of marine-type acetate dope to be brushed on and dried two hours or more between coats in a warm room. 2. One or more coats of marine-type canvas filler to be applied until weave of canvas is filled level. Dry hard in a warm room until ready to water sand with ½ and 00 sandpaper. Dry twenty-four hours. Touch up filler if spots appear. Resand. 3. Bottoms to be given three or more coats of marine-type, hard racing enamel in green, buff, or bronze; first coat to be dried hard for not less than three days and water sanded with wet-or-dry 4/0 paper. Dry overnight before recoating. 4. Last coat to be applied full bodied by brush or spray and left in full gloss. 5. Boot-topping, if used, to be two coats marine-type gloss black or white, well dried and sanded between coats. Last coat to be left in full gloss. 6. All exposed trim, woodwork, and decks to be finished natural, as follows:

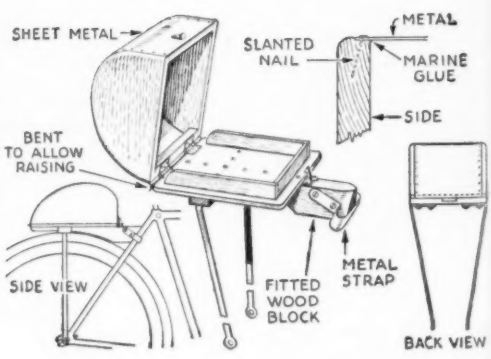
a. Sand clean and bright with 4/0 open-faced garnet sandpaper and block. b. Fill as required with hard-drying marine-type wood filler and wipe clean. Dry twenty-four hours. c. Varnish with one part marine quick-drying spar varnish and one part pure turpentine. Dry hard eight hours. d. Putty glaze as needed. Dry hard and sand level. e. Revarnish full body with four-hour marine spar. f. Dry hard, resand, and revarnish to four coats. Leave last coat full gloss.

(TO BE CONCLUDED)

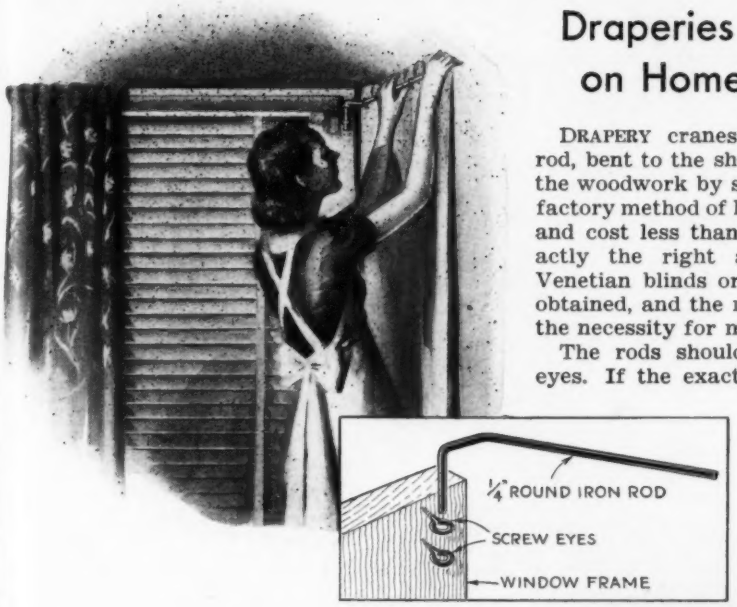
Weatherproof Package Carrier Added To Bicycle

IT IS no trick at all for a handy boy who rides a bicycle to make a streamline, weatherproof carrier as shown for holding his lunch, books, and extra jacket.

The support running from the bottom of the carrier to the rear axle is an old fender brace. The bottom may be of plywood or ⅜" birch or ash; and the sides of ¾" to ⅞" white pine or spruce, rabbeted just enough to take the tin or galvanized-iron top, which is set in marine glue flush with the top edge of the sides and nailed at 1" intervals. The wooden tongue fitting the fender and the rear forks is nailed and screwed to the bottom of the deck and held to the forks with a leather-lined sheet-metal strap.—JACK HAZZARD.



Draperies Hung Invisibly on Homemade Cranes



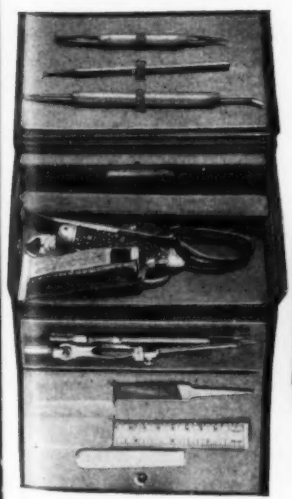
DRAPERY cranes made of ¼" round iron rod, bent to the shape shown and attached to the woodwork by screw eyes, provide a satisfactory method of hanging draperies invisibly, and cost less than fifteen cents a pair. Exactly the right amount of clearance for Venetian blinds or other projections may be obtained, and the method of attaching avoids the necessity for making holes in the plaster.

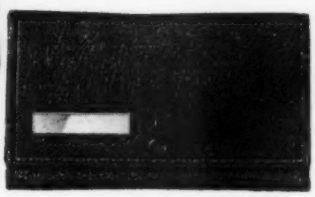
The rods should fit snugly in the screw eyes. If the exact size is not available, use screw eyes with somewhat smaller openings and spread to the desired size with a tapered punch. The rods and eyes may be gilded or painted to match the woodwork.—H. W. T.

Lawn-Mower Sharpener Has Universal Drive

A SHORT shaft with universal joints at each end is an aid in driving lawn mowers while being sharpened. In the set-up illustrated, reduction gears from a junked washing machine are used to gear down the speed, and the shaft has a chuck that will fit any size lawn-mower shaft. The mower may be sharpened even at the extreme angle shown, although as a rule the drive is almost straight. The wooden roller usually rests on the block in the center of the tray.—JAMES L. BURDEN.

Pocket Kit Holds Craftwork Tools





Small tools for various types of craftwork are carried conveniently in a manicure box

THIS compact kit for small tools, adapted from a manicure box purchased at a dime store, is invaluable to the craftsman who has no regular workshop.

On one flap are two leather-working tools and a dental probe; on the other (in pockets made by slitting the lining and loosening it) are a file, an emery board, and a small celluloid ruler. The bottom is covered with velvet, cemented over reënforcing cardboard and over a strip of quarter-round molding at the free edge. At the back, the cardboard can be tilted forward to reveal small pockets for razor blades, paper clips, and needles. On the velvet, either attached by elastic straps or loose, are small pliers, wire cutters, penknife, and the like.—WINIFRED G. HAMMOND.

Fighting Plane in Miniature

. . . A CAREFULLY DETAILED EXHIBITION MODEL OF THE SPEEDY GRUMMAN F3F-1

In building the model, you will find this photo of the real plane is of considerable help. It was supplied by the U.S. Navy Recruiting Bureau

By
DONALD W. CLARK

SPECIFICATIONS OF GRUMMAN F3F-1

Span	32′	Useful load	1,230 lb.
Length	23′ 3″	Gross weight	4,100 lb.
Height	8′ 9″	Fuel	110 gal.
Empty weight	2,870 lb.	Oil	9 gal.

ENGINE

Pratt & Whitney Twin Wasp Junior, 650 h.p. at 2,200 r.p.m. at 7,500 ft.

PERFORMANCE

Maximum speed	240 m.p.h.	Service ceiling	29,000 ft.
Cruising speed	215 m.p.h.	Rate of climb	2,700 ft./min.
		Cruising range	720 mi.
		Landing speed	65 m.p.h.

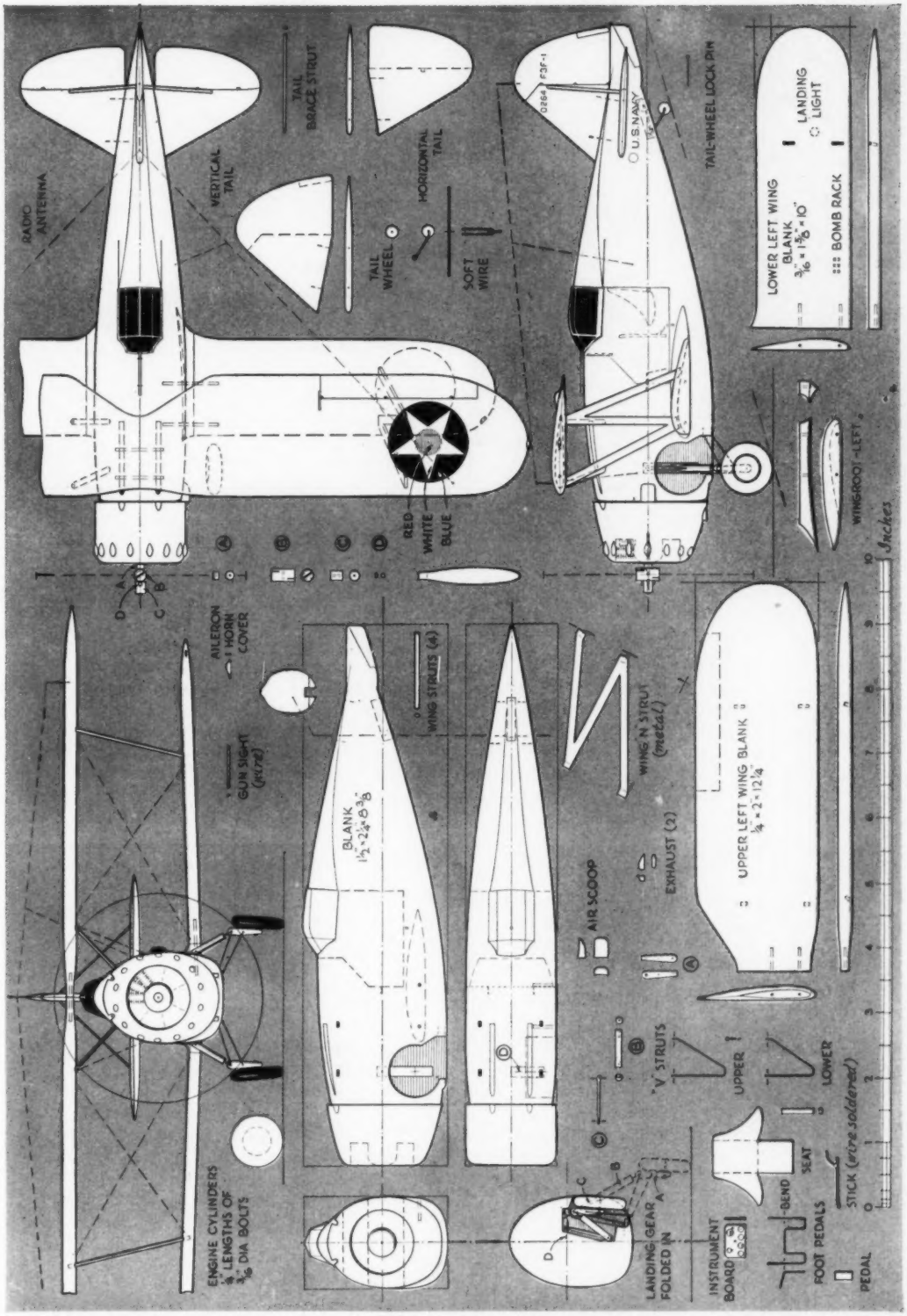
MODEL airplane builders who are not content until they have added every possible detail will find a job to challenge their skill in this scale model of the Grumman F3F-1 Fighter. Opening the hinged section of the fuselage of this model reveals the inside of the cockpit, which has, of course, been greatly simplified. Those who do not wish to attempt so much work may omit the cockpit and the folding landing gear. The wheel struts could be made rigid by cementing them in place, while the tail-wheel support could be set into a hole.

Our regular scale of ⅜″ equals 1′ has been followed, and the drawings are largely self-explanatory. The cowl recess is cut in the usual way, and the cylinders are represented by cementing fourteen sections of 3/16″ diameter bolts in place. The inner set should be split in two and fastened first.

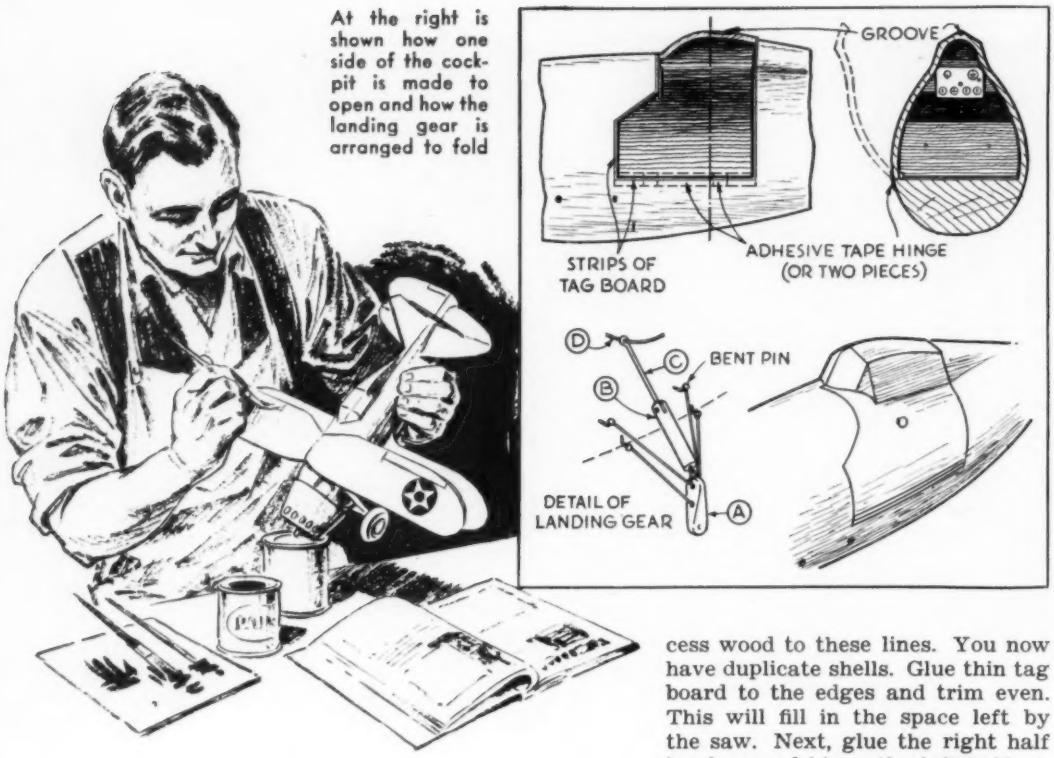
The landing-gear struts are wood and soft wire. Common pins, bent as shown and cut off and pointed, serve as turning points for the struts when pushed into the fuselage at the proper positions. *D* is a curved wire set into the upper part of the wheel pocket on which the top end of strut *C* rides when the gear is folded or unfolded. This hole should be a trifle oversize. Both ends of *C* are flattened and drilled. One corner of strut *C* is not rounded. This will keep struts *B* and *C* from moving out beyond dead center when the gear is let down. If all turning points except the one at *D* fit snugly, the wheels will stay put—either up or down.

The wheel pockets can be cut in with a drill, knife, and chisel. A small wood-carving tool set is useful for smoothing up the pockets.

The tail-wheel mounting is simple. Pulling the lock pin out far enough to clear the wire support allows the wheel to be pushed into the pocket. Pushing the pin in again locks the wheel in the raised position. The same



Three views of the assembled model and detail drawings of the important parts, with a scale in inches


At the right is shown how one side of the cockpit is made to open and how the landing gear is arranged to fold
GROOVE
STRIPS OF TAG BOARD
ADHESIVE TAPE HINGE (OR TWO PIECES)
D
C
BENT PIN
B
DETAIL OF LANDING GEAR
A

pin will lock it in the lowered position also.

With the finest-toothed coping saw, cut out the cockpit portion of the fuselage, being careful to preserve the corners. Mark a center line on top of this block lengthwise and cut it in two. Parallel with the outer edges, mark lines 1/16″ in and carve away the excess wood to these lines. You now have duplicate shells. Glue thin tag board to the edges and trim even. This will fill in the space left by the saw. Next, glue the right half in place and hinge the left half. A small groove enables the cover to be opened.

The seat and other fittings may be metal, fiber, or cardboard. Paint these parts, the cockpit, and the wheel pockets light gray. The exterior of the model is painted aluminum except the top surface of the upper wing, which is yellow. All the details are black.

BRASS POLISH

[*FORMULAS*]

Tripoli or silex	3 oz.	White vinegar	2 oz.
Tartaric acid	1 dram	Alcohol, denatured	1 oz.
Rottenstone, powdered	1 oz.	Gasoline	14 oz.

Apply with a cotton flannel pad, let dry, and polish with fresh cotton flannel. Finish with an old but soft and clean chamois. If a dull-rubbed effect is desired, add FFF pumice stone to a portion of the polish and use it on the surfaces which are to be dull.

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Jackknife Model OF A Civil-War Gun

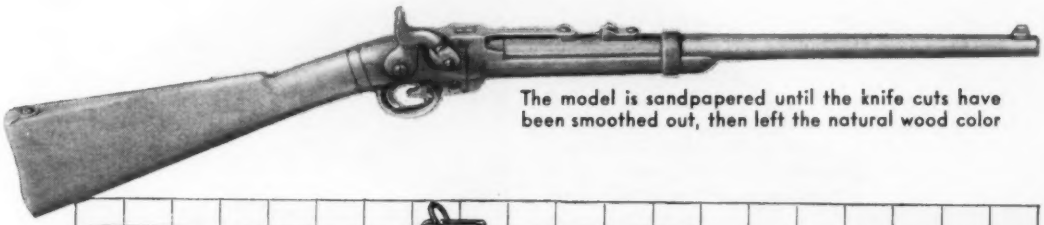
By CARL G. ERICH

HERE is a half-size whittled model of a Civil-War gun of the cap-and-ball type. The original is marked "Poultney & Trimble, U.S.A., Smiths Patent, June 23, 1857."

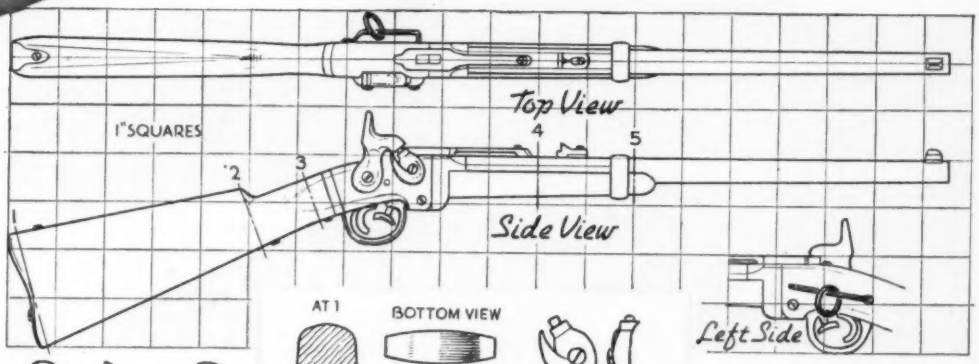
Make a paper pattern and transfer it with carbon paper to a white-pine board ⅞" thick, 4½" wide, 20" long. Cut out the design with a jig, band, or coping saw. Draw a pencil line all along the center of the edge; then carve the gun to shape.

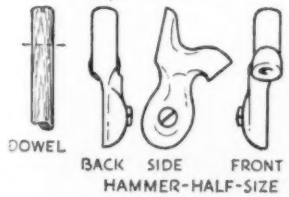
When cutting the trigger and guard, work delicately across the grain. The hammer and cap holder are best made separate; use glue and cut-off pins to hold them in place. Bore a hole in the front end of the barrel. Make very fine V-cuts at the various markings. Use dowel sticks to represent the screw heads.

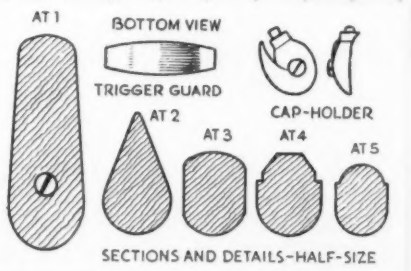
I think models of this type look best in the natural wood, but they can be painted, if desired. The iron parts in that case are enameled a gun-metal color, and the wooden parts stained walnut.



The model is sandpapered until the knife cuts have been smoothed out, then left the natural wood color







The assembly drawings are a quarter the size of the model, and the details at left are half size. Leave all the delicate parts like the trigger and guard to the last to avoid breaking them

Mounting a Bicycle Wheel to Absorb Road Shocks

FOR the newsboy who must jump curbs, for the Boy Scout who rides narrow and rough country roads and trails, and for the chap who likes to tinker, this bicycle attachment offers interesting possibilities. It is a sort of cantilever front wheel.

The extension of the forks in which the wheel is mounted is made from an old aluminum bicycle stand. Bend it first, saw away any unevenness in the length of the arms, and drill for the axle and the bolts holding the extension to the forks. These two sets of holes are 3″ apart, center to center. A length of screen-door spring will do for a spring if the rider is light in weight. It is attached as shown with a piece of baling wire. For heavier persons, stronger spring and wire are necessary. This arrangement may be easily removed for ordinary riding.—J.H.

Builds *Mayflower* Model Entirely of Copper

CONSTRUCTED entirely of copper from POPULAR SCIENCE MONTHLY blueprints, the 21″ long model of the *Mayflower* illustrated below was built by Stanley Zabaglo, a roofer on the maintenance staff at the Carnegie Institute of Technology, Pittsburgh, Pa. The work required about 400 hours.

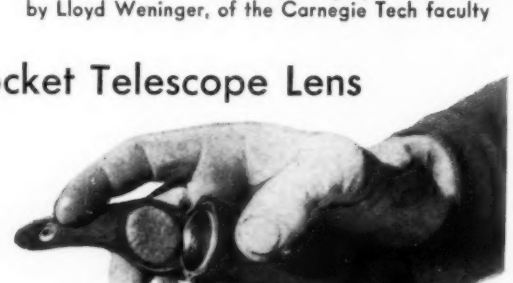
While on exhibition in the sheet-metal shop, the model was so much admired that the alumni of Carnegie Tech selected it as an appropriate gift for Dean Arthur W. Tarbell upon his retirement last June after thirty years at the Institute. Dean Tarbell, a native New Englander, is the author of "Cape Cod, Ahoy."

Zabaglo is planning to build next the U. S. *Constitution* and the *Revenge,* other ships in our blueprint series.

An all-copper model. The photograph was made by Lloyd Weninger, of the Carnegie Tech faculty

Soft Felt Pad Protects Pocket Telescope Lens

IF YOU have had occasion to carry a small telescope in your pocket for any length of time, you have probably been annoyed at the coating of dust that accumulated on the object lens. Provided the telescope is already fitted with a leather case, the trouble can be almost entirely overcome by sewing a disk of soft felt to the flap of the case as illustrated at the right.—ROY S. MACNEILL.



Booth of the Regina (Sask.) Homeworkshop Club at a provincial fair. Demonstrations on power machinery were given several times a day by some of the members

Home Workshop Movement Grows Rapidly in Canada

BY MEANS of exhibitions, contests, and participation in civic affairs, craftwork and model clubs are rapidly promoting the home workshop hobby throughout Canada. Thirty-one clubs have already been formed under the auspices of the National Homeworkshop Guild, and there will undoubtedly be a great many more by the end of the year.

Several thousand persons saw the exhibition sponsored by the ***Regina (Sask.)*** Homeworkshop Club at a provincial fair. Members demonstrated power tools borrowed from a local hardware store, and craftwork articles were displayed on four tiers at the back of the booth. Nearly sixty applications for membership were received.

The ***Edmundston (N.B.)*** Hobbyist Club is sponsoring a contest to design two arches to be erected at the east and west entrances of the town. Each contestant must submit a completed model and plans. Three prizes will be awarded. A window display is scheduled for April and a large exhibition for next fall.

So much interest has been displayed in model making that the Society of Model Engineers, ***Ottawa, Ont.***, has obtained the coöperation of a local radio station, which announces the time and place of meetings. The members will have several speed boats ready by spring and are now planning to erect a track for live-steam model locomotives. A. P. Abolit and A. E. French displayed models at recent meetings.

The Kerrisdale Homeworkshop Club, ***Vancouver, B.C.***, has arranged to have a series of demonstrations given on power tools, begin-

A Record Month for the Guild

HEADQUARTERS of the National Homeworkshop Guild in New York City experienced a record period of activity recently when forty-one clubs joined within one month. One club was from Canada; the rest were distributed among twenty states. During the same month, 421 requests were received from persons desiring information on how to start clubs in their neighborhoods. This is another indication of how the home workshop hobby is sweeping the country.

ning with the circular saw . . . Bruno Perinie, of the ***Granlea (Alta.)*** Homeworkshop Club, has built an electric welder and a drill. Arnold Friedenburg erected a wind charger in order to electrify his workshop. Joseph Schile made a guitar and banjo . . . The ***Angusville (Man.)*** Homeworkshop Club is coöperating with the local school in conducting classes for boys. An "achievement day" will be held this spring when prizes will be distributed for the best work done . . . A club workshop is planned by the ***Preston (Ont.)*** Homecraft Club.

A wide variety of programs has been enjoyed by the ***Peekskill (N.Y.)*** Homeworkshop Club during the past year. Among the talks and demonstrations were the following: wood inlaying and marquetry, Edward Kurzhals; copper etching and oxidation, Thomas Monteleone; lens grinding, Frank P. Tompkins; pastel painting, Theodore Bee; photographic illumination, Harry Rigby, Jr.; wiping lead joints, John Donohue and Charles Martin; metal spinning, Thomas Monteleone; abrasives, Harry L. Towers and Dr. Edson R. Brewer; polishing steer horns, George C. Court; veneer paneling, Gaspar Constantine; casein glue, Jerry Reen; "Experiment with Casein Glue on Three-Ply Disk," Arthur A. Dix.

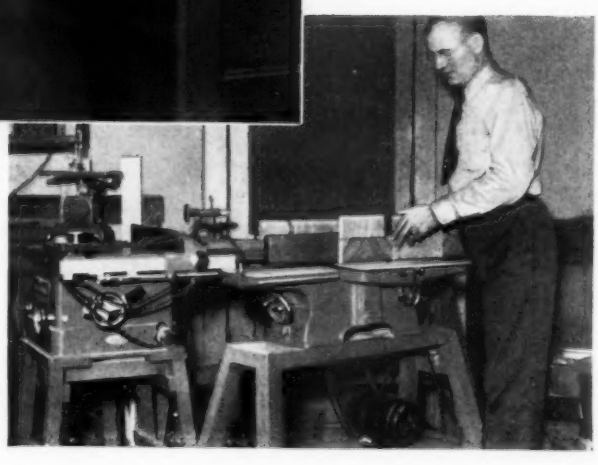
When the ***Seattle (Wash.)*** Homeworkshop Club was first organized, it had the use of machinery owned by a local concern. Now that the club is on its feet, the club has decided to purchase its own equipment. An intensive membership campaign is being conducted, and the committee hopes soon to have an active list of 100 or more.

The ***Great Falls (Mont.)*** Homeworkshop Club recently coöperated with a local bank by building bird houses for a special display. Lawn and porch furniture will be made this spring. Window exhibits are held every four weeks. Two more members, S. A. Eberhardt and Curt Weismann, have built their own homes, making a total of four in two years.

Another Guildcrafter who has constructed his own house is Julian Knapp, of the ***Ware (Mass.)*** Homeworkshop Club. He had never done any carpentry work before, yet the only outside assistance he needed was for a mason to put up his chimney. He did his own plumbing, wiring, carpentry, and painting.

Charles Leuthardt demonstrated veneering processes before the ***Nutley (N.J.)*** Homeworkshop Club recently . . . When the ***Walla Walla (Wash.)*** Homeworkshop Club held its exhibition, Walter Taylor, president of the Walla Walla Camera Club, photographed the show . . . Through excellent newspaper publicity, the Handicraft Homeworkshop Guild of ***Waterbury, Conn.***, has been able to increase its membership considerably . . . F. C. DeBoe was host to the ***Vicksburg (Miss.)*** Homeworkshop Club when moving pictures were shown . . . The following hobbies were displayed by the Timbercraft Homeworkshop Club, ***New Bedford, Mass.***, at its exhibition the latter part of February—photography, sports, art, coins, models, woodworking, and metal working . . . More than 500 gifts were distributed by the Bison Builders' Guild, ***Buffalo, N.Y.***, last Christmas, and since then many letters of appreciation have been received. The members are building a motor boat designed by Earl Sanderson.

Approximately 250



Left, Merle Hedrick of the Saginaw (Mich.) Homecraft Club retouches the emblem he made. Below, Charles Krause, another member, in his workshop

Two views of the fourth annual exhibition of the Walla Walla (Wash.) Homeworkshop Club. Even beds were on display. At left is the prize-winning table made by John Linker

persons were guests of the ***Lynn (Mass.)*** Homeworkshop and Handicraft Club at an open house. The club's equipment was demonstrated and various projects displayed. A total of 2,100 toys were made or repaired for poor children . . . The ***Trenton (N.J.)*** Homeworkshop Guild is conducting a series of electrical experiments under the direction of the president, Charles A. Mazatas . . . William T. Russell, former president of the ***Pittsfield (Me.)*** Craftsmen's Club, recently returned to the town and reorganized the group, which had been inactive since he moved away . . . Walter Sweeney demonstrated upholstering before the ***Fall River (Mass.)*** Homecraft Club . . . Mark Hains, of the ***Topeka (Kans.)*** Homeworkshop Club, makes at least one new toy a week and gives them to the Salvation Army. His three children are his proving ground—they try out each new toy.

Henry J. Jung gave an illustrated lecture on modern furniture design before the Hardwood Homeworkshop Club, ***Neenah, Wisc.***, and announced that he would give a prize of $15 for the most original piece of furniture designed by a member. The club has voted to give a $5 prize to the person who brings in

the most new members during 1939.

Col. Donald W. Fraser, president of the Orchard Park Homework Club, ***West Lynn, Mass.***, was given a surprise dinner recently in honor of the splendid work he has done in supervising the job-placement division of the club. The affair marked the group's ninth anniversary, and all who had attended the first meeting were present.

At a recent meeting of the ***LeRoy (N.Y.)*** Homeworkshop Club, Frank Hall demonstrated how to joint and file circular and hand saws, and Dr. Bernard S. Stelmaszyk projected Kodachrome films. The question box has proved popular.

Sioga Homeworkshop Club of New York City working in the club shop. This picture won the $5 prize in a photo contest for Guild members

The South Shore Homeworkshop Club, ***Quincy, Mass.***, enjoyed a lecture and demonstration on wood filling, staining, varnishing, shellacking, and waxing at the home of Stephen H. Page. The following session was held in the workshop of Mr. Lowe . . . Working in conjunction with the ***Lewiston (Idaho)*** Junior Chamber of Commerce and the Lewiston Welfare League, the Lewis-Clark Homeworkshop Club repaired 1,000 toys . . . Demonstrations on the lathe and with a hand grinder were given before the ***Sacramento (Calif.)*** Homecraft Club . . . Three exhibitions are planned by the ***Buffalo (N.Y.)*** Homeworkshop Club. Work has started on a new clubroom. Richard Platek and Ted Jendzejczak won the prizes in a recent contest . . . The ***Cuyahoga Falls (Ohio)*** Homeworkshop Club coöperated with the local firemen in repairing toys last December, but intends to conduct its own Christmas project this year . . . Furniture making and repair were shown to the ***Ware (Mass.)*** Craftsman Guild when the members visited a factory.

An exhibit to illustrate the various forms of mechanical motion, such as the crank, cam, lever, and screw, is being built by the Capital Homecraft Club, ***Washington, D.C.***

A letter of appreciation from the Colorado State Home for Dependent Children has been received by the ***South Denver (Colo.)*** Homeworkshop Club for the toys and other articles presented to the institution. Part of the letter follows: "You may be assured that when we were first notified of your intentions, we had no idea that this outlay of articles would be so numerous or so well constructed. There is no doubt that our children will be delighted with these things, and will find many of them very useful in the years to come."

Guild Offers Bulletin on How to Start a Club

National Homeworkshop Guild

347 Fourth Avenue, New York

Please RUSH by return mail your special bulletin giving complete information on how I can start a home workshop club and become an affiliate of the Guild. For your use in sending me this literature, I am inclosing a large (legal size), self-addressed, and stamped envelope.

NAME.....

ADDRESS.....

CITY..... STATE.....

(Please print very clearly)

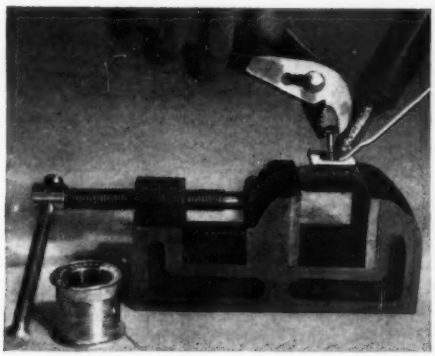
HAVE you a workshop? If so, you'll enjoy meeting regularly with other amateur craftsmen, exchanging ideas, and seeing demonstrations of various phases of the hobby. These are just a few of the benefits in belonging to a home workshop club. In addition, the National Homeworkshop Guild furnishes free monthly bulletins, job sheets, and other literature. There are no dues to pay. Full particulars on how to start a club in your neighborhood will be sent upon receipt of a stamped envelope. Membership in Guild clubs is open to all persons 16 years of age or older. Use the coupon at the left.

Small Clothes-Drying Rack Fits Over Radiator

FOR drying stockings, handkerchiefs, washable gloves, baby's apparel, and other small articles over a radiator, a convenient rack may be made as illustrated. When not in use, the rack folds flat and is stored behind the radiator.

Any nonrusting metal may be used, but the rack shown is of 3/16" round aluminum rods riveted together with brass escutcheon pins. The ends rest in four sockets made of aluminum tubing. These are fastened to the radiator with flexible straps of brass tightened with bolts and nuts. The size and position of the straps will vary with the type of radiator. Miniature clothespins are used to hold the apparel on the rack.—BERTRAM BROWNOLD.

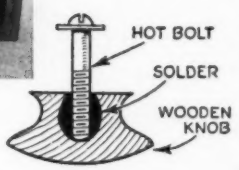
The rack is supported by four sockets as at the left. Toy clothespins hold the wash in place



The bolt was held in place and the enlarged cavity filled with solder

Loose Wooden Drawer Knob Fastened with Solder

AFTER trying several methods of fastening a loose wooden drawer knob, I enlarged the hole in it as shown. The bolt was then heated red hot, and my son held it in the hollow of the knob with pliers while I flowed solder into the hole. Neither acid nor soldering flux was used so the solder would not stick to the bolt. A few moments later, after the solder had cooled, I unscrewed the bolt and found that a perfectly threaded core of metal had been formed within the knob.—E.C.H.



House Key Concealed in Slot Cut in Back-Door Screen

WHEN it is necessary to leave a house key hidden outside for the use of some member of the family who does not carry one, a good hiding place may be prepared in the hinge edge of the back-door screen. Remove the screen door and cut a slot about ½" wide, 1" deep, and 4" long. A piece of wire, shaped like a staple, is driven midway across the slot to keep the key in place. When the door is rehung, this slot will never be detected, yet the key is readily reached.—ALBERT W. STEIN.

Convertible

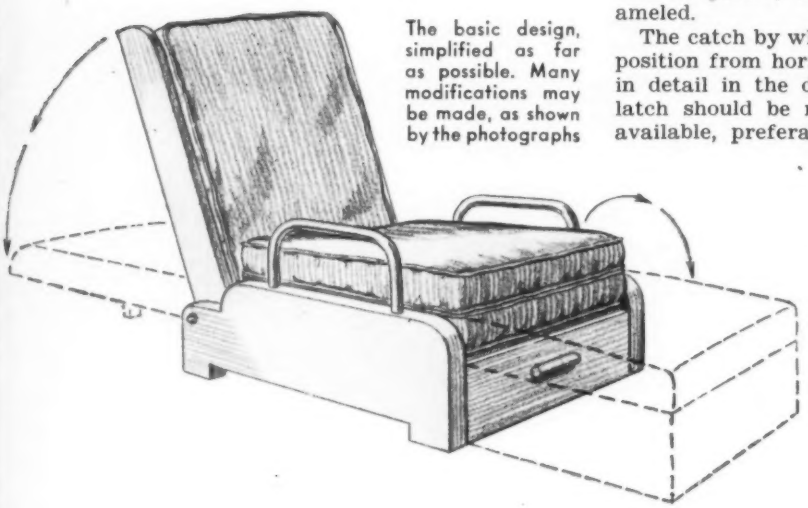
An adjustable back, which may be tilted to any angle, makes this a particularly comfortable chair for lounging or reading

MODERN trends in design emphasize the advantage of multiple uses for furniture. The unusual, but easily constructed, combination chair shown in the accompanying illustrations can be instantly converted into either a *chaise longue* or a bed. A storage drawer is also provided.

All the work may be done with hand tools, although power tools will speed up construction. It will be noted that the drawings show the chair in the plainest possible form, but there are infinite opportunities for minor changes to suit the taste of the builder. Some such changes in design were incorporated into the chair that appears in the photographs. The hinging of the back is also slightly different; the method shown in the drawings, however, is simpler and will be found entirely efficient.

Each side of the frame is made of two pieces, as shown in the drawings. The stock should be 1″ by 10″ by 28″. Heavy wood screws, countersunk and with the holes puttied, form the simplest type of joint, but a mortise-and-tenon joint is far superior.

The seat bottom is made of ½″ plywood and is set solidly into grooves in the side-pieces. The drawer bottom is ¼″ plywood.



The basic design, simplified as far as possible. Many modifications may be made, as shown by the photographs

The arms are ⅞″ pipe bent to fit on a suitable bending jig; they are removable so that the chair may be converted into a bed. Decide upon the height desired before bending. The arms fit into ⅞″ holes drilled into the sides of the frame. Should any tendency to looseness develop, pieces of slightly larger pipe may be inserted in the holes as sleeves. Padded arm rests may be added. If an extra modern touch is desired, the arms can be chrome plated, otherwise they may be enameled.

The catch by which the back is held in any position from horizontal to vertical is shown in detail in the drawings. The ratchet and latch should be made of the hardest wood available, preferably hickory. It is obvious that any weakness here or carelessness in making or fitting the parts may result in the failure of the mechanism to stand up under hard usage.

A light door spring will be found satisfactory for keeping the latch under tension. The release wires for the catch run through a series of screw eyes and are attached to a ring in

Easy Chair BUILT IN THE MODERN MODE

IT CHANGES INSTANTLY INTO A CHAISE LONGUE OR A BED

By R. DeWitt Miller

With the arms removed and the back let down, the chair will serve in an emergency as a couch

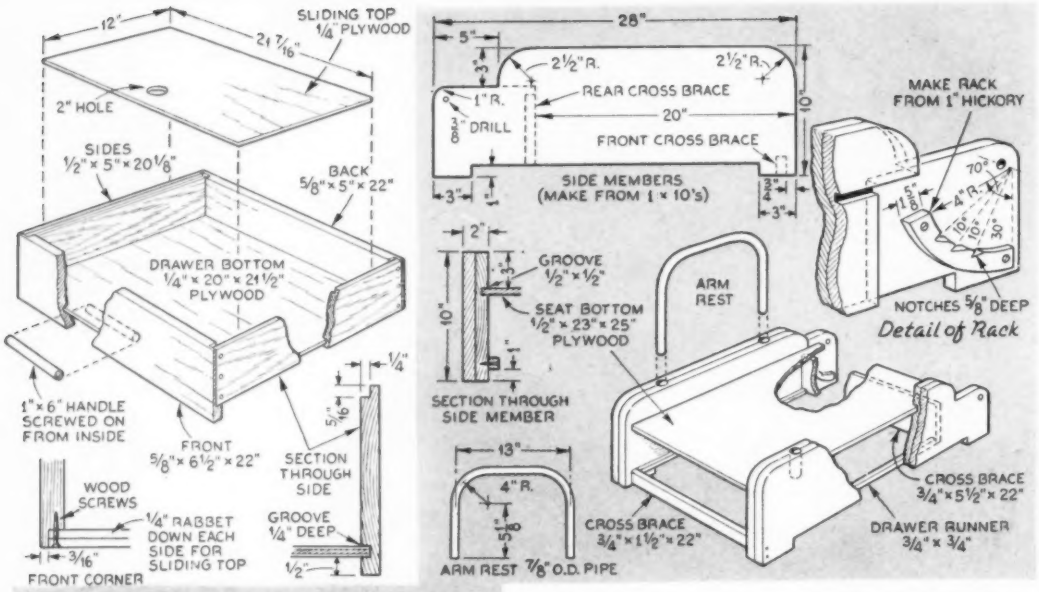
the middle of the back. By pulling this ring, the catch is released. The wires run through holes drilled in the frame of the back. If no long drill for this purpose is available, a piece of heavy steel wire or drill rod may be flattened on the end and filed into an efficient V-drill.

As an additional support, a hinged brace or auxiliary leg, may be fastened on the inner surface of the back if desired. This should be held out of the way by a catch except when the back is in a horizontal position; then it should be allowed to drop down and rest on the floor, thereby supporting the end of the back. It is even better to use two such legs, one on each side. These will give additional security. The back is hinged to the frame with ⅜" carriage or wagon bolts with washers and lock nuts.

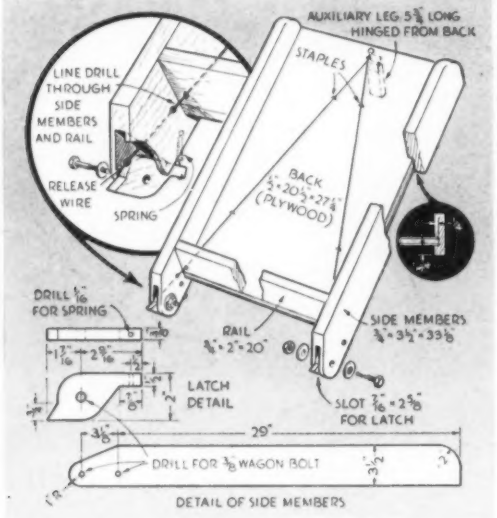
The drawer also acts as the support for the folding portion of the seat cushion when the chair is used as a *chaise longue* or bed. The front of the drawer is made of ⅝" stock, which extends 1½" below the bottom, thereby giving a finished appearance. The drawer slides on cleats screwed to the inner surfaces of the sides of the frame. In the photos the front of the drawer projects above the sides. A plywood half-top to the drawer is pulled

The drawer provides a convenient storage place. It has a top that slides forward to support a cushion when the chair is used as a bed or in the way shown below

For use as a chaise longue, the top seat cushion folds forward to rest on the drawer



The main frame, arms, and ratchet detail. At the left above is shown the construction of the drawer


AUXILIARY LEG 5 3/4" LONG HINGED FROM BACK
LINE DRILL THROUGH SIDE MEMBERS AND RAIL
STAPLES
RELEASE WIRE
SPRING
BACK 3/4" × 20 1/2" × 27 1/4" (PLYWOOD)
DRILL 1/16" FOR SPRING
RAIL 3/4" × 2" × 20"
SIDE MEMBERS 3/4" × 3 1/2" × 33 1/8"
LATCH DETAIL
SLOT 7/16" × 2 5/8" FOR LATCH
29"
DRILL FOR 3/8" WAGON BOLT
DETAIL OF SIDE MEMBERS

The assembled back frame and details of the side members and catch, the latter of very hard wood

forward as a support for the front cushion when the chair is extended. It runs in 1/4" by 5/16" rabbets in the top of the sidepieces.

The simplest method of upholstering is to use three overstuffed cushions from an old couch. After slip-over covers in the desired color are put on the cushions, the edges are sewn together. One of these sewed edges acts as a hinge between the bottom seat cushion and the back cushion; the second allows the top seat cushion to be swung forward so as to rest on the drawer when extended.

Some sort of snap fastening or tie should be used to hold the rear of the top seat cushion in place when it is folded back. White or ivory enamel gives an appropriate modern finish to the frame, but any desired color scheme may be followed.

LIST OF MATERIALS

Well-seasoned pine: 2 pc. 1" by 10" by 28"; 2 pc. 1" by 10" by 23"; 2 pc. 3/4" by 3 1/2" by 33 1/8"; 1 pc. 5/8" by 6 1/2" by 22"; 1 pc. 5/8" by 5" by 22"; 1 pc. 3/4" by 5 1/2" by 22"; 1 pc. 3/4" by 1 1/2" by 22"; 2 pc. 1/2" by 5" by 20 1/8"; 1 pc. 3/4" by 2" by 20".

Pine: 2 pc. 3/4" by 3/4" by 18 1/2"; 1 or 2 pc. 1" by 2" by 5 3/4" (optional for auxiliary leg or legs).

Plywood: 1 pc. 1/2" by 23" by 25"; 1 pc. 1/2" by 20 1/2" by 27 1/4"; 1 pc. 1/4" by 20" by 21 1/2"; 1 pc. 1/4" by 12" by 21 7/16".

Broom handle: 1 pc. 6" long.

Hardwood, preferably hickory: 2 pc. 7/16" by 2" by 4"; 2 pc. 1" by 5" by 6".

2 pc. 7/8" outside diameter steel pipe or tubing 30" long (for arms).

2 wagon bolts 2" by 3/8" with 2 nuts (one a lock nut) and 2 washers for each.

2 short door springs.

1 pc. steel wire, 6' long.

1 iron ring, 1" diameter.

4 screw eyes or staples.

1 square 1" hinge and catch.

3 old davenport or overstuffed cushions approximately 20" by 25" each.

3 slip-on covers for the cushions.

2 snaps or ties for holding top cushion.

Assorted nails and screws, glue, etc.

Gardener's Line Kept Tight with a Coil Spring

"HOW can I keep my garden lines tight and still work along them freely?" is a question often asked by gardeners. It can be done by the method illustrated. For the stakes, use 5/16" cold-rolled steel rod with a 1" eye bent in the top. Cut the stakes 18" long so as also to serve in spacing the rows. An old tire-chain evener spring is also required. It is cut in half, the cut end annealed, and a new loop made. This is then heated to redness and hard tempered in cold water. Enamel the stakes and spring red.

The best string is two-strand mason's cord, which will not twist and kink when wound on one of the stakes. For curves and rolling surfaces, the string can be held with clothespins cut as shown.—R. G. W.

Half of an old tire-chain evener holds the line taut, yet the gardener can push it aside enough to work freely along the row

Children's Coat Hangers

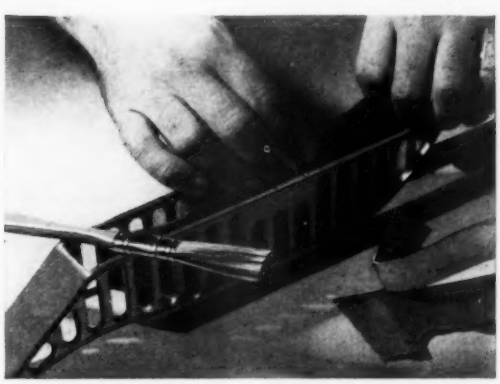
A CHILD can be trained to hang up his coat in a clothes closet if he is provided with a coat hanger within his reach, as illustrated. This is made by replacing the short hook on an ordinary wooden coat hanger with a long hook obtained by cutting and bending a wire coat hanger.—ROBERT BLICKENDERFER.

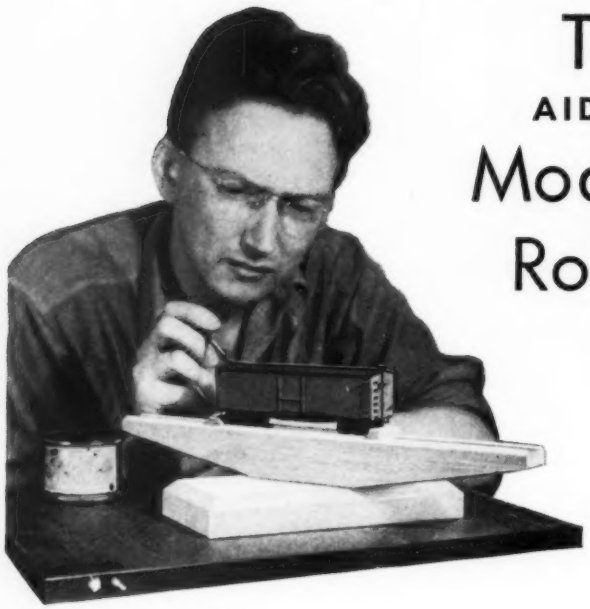
Fasteners for Camp Equipment

WHEN slide fasteners have to be replaced on duffel bags, tent flaps, or other equipment subject to hard usage, let the new fastener extend like a loose tab about ½" beyond the edge of the material. Such a fastener never opens accidentally.—CHARLES VOGT II.

Rubber-Lined Guard Used with Cutting Wheels

IF LINED with strips of inner-tube rubber to confine flying particles of grit and metal, a regular circular-saw guard may be used in place of a special guard with abrasive cutting wheels. Coat the inside of the guard with shellac, let it dry, and apply another coat before pressing the rubber in place.—K. M.

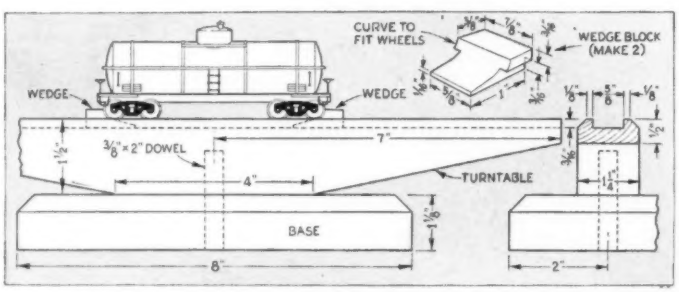




Turntable AIDS IN PAINTING Model Railway Rolling Stock

FOR painting model railroad cars and engines, a turntable of the type illustrated is invaluable. Once the car or engine is placed on the turntable, it is unnecessary to touch the work until it is dry.

The material can be found in the scrap box. The drawings give dimensions for a turntable designed to hold one passenger car or two freight cars of HO gauge. The base is made from a piece of white pine 1⅛" by 4" by 8"; a hole is drilled in the center for the ⅜" by 2" dowel that serves as a pivot. The turntable itself is a piece of white pine 1¼" by 1½" by 14". A groove ⅝" wide and 3/16" deep is made in the center of one side of this piece. The sides of the groove act as tracks on which to rest the model. A ⅜" hole for the pivot is bored in the center of the side opposite the groove. For appearance sake, if for nothing else, the ends of the turntable may be tapered as illustrated. To complete the equipment, two wedges will be needed for each car to prevent it from rolling off the turntable.—GEORGE W. NIEDERMAIR.



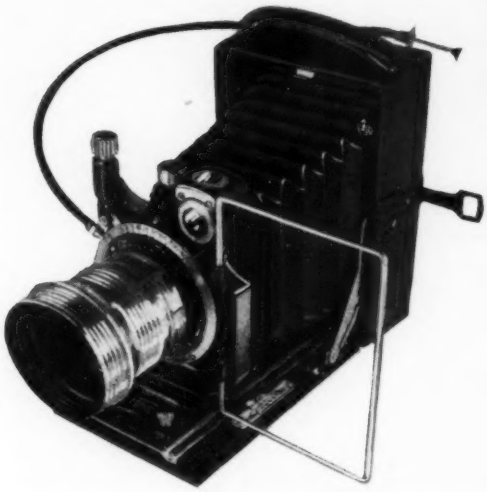
Front and end views of the painting turntable. The dimensions are for HO-gauge equipment, but may be enlarged to suit any other gauge

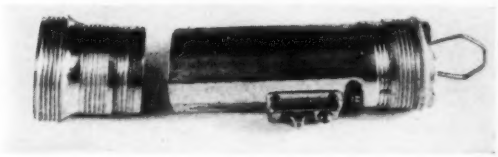
Thin Asphaltum Varnish Stains Model Ties

WOODEN ties for a model railway system can be stained realistically with black asphaltum varnish thined about fifty percent with gasoline, benzine, petroleum spirits, or any spirit thinner that happens to be available. Use an old household strainer to dip the ties in the thinned varnish and spread them on newspapers or a discarded window screen to dry. This stain gives a deep black color without the objectionable odor of creosote. White or sugar pine is best for making the ties, which can be ripped into narrow strips on a circular saw.—C. A. VOELCKEL.

End of Old Flash Light Serves as Lens Shade

A LENS sunshade for many types of cameras can be made from the large end of an old flash light. It should be cut with a hack saw back of the threads at the end of the main tube. This makes it possible to adjust the length of the shade to meeet specific needs. In case it does not fit exactly, cut slits around the end and bend the sections in or out. A flash light using large cells will just fit over a standard filter-adapter ring for a 32-mm. lens mount. The inside of the shade should be painted dead black. Ordinary black ink will do. The nickel on the outside makes it a neat-looking attachment.—C. W. R.



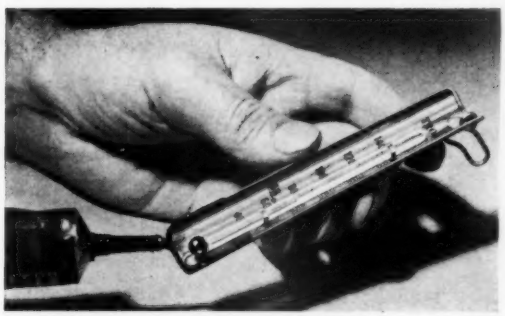


Condensing Lens Ground to Act as a Diffuser

FOR average work, many photographers prefer an enlarger in which both condensers and a diffusing medium are used together. This combination may be obtained by grinding the flat surface of the upper or lower condenser with valve-grinding compound so as to obtain an even, ground-glass finish.—W. K.

Small Mirror Shows Sitter How Portrait Will Look

THE sitter for a camera portrait at home can judge better whether his or her pose and expression are satisfactory if a small mirror (about 5″ by 7″) is attached to the tripod immediately below the camera.



Rubber-Edge Thermometer

WHEN a photographic thermometer is used of the type having sharp metal edges, it can be prevented from scratching negatives in the developing tray by coating the edges with plastic rubber from a tube. Apply the semifluid rubber rather heavily.

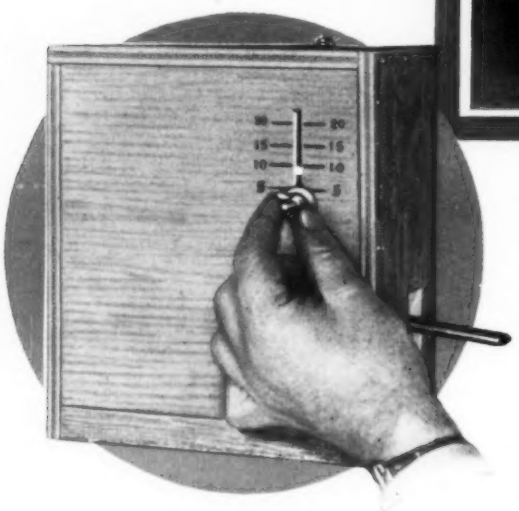
Homemade Foot Switch

By LOUIS HOCHMAN

TIMING enlargements in the darkroom need no longer be a problem to the amateur. This easily constructed automatic foot switch, which rises slowly after being depressed, throws a switch at the end of a designated number of seconds. It can be adjusted for any interval up to twenty seconds or more, and any exposure may be doubled or tripled by stepping on the pedal twice or thrice. The device is therefore especially valuable for making duplicate enlargements because the exact exposures can be given each copy automatically.

The switch is housed in a box 8" by 8¾" by 4½". The wooden lever is ¾" square and 6½" long, and one end is attached to a compression chamber, while the other end carries the pedal. A small coil spring, attached to the end of the pedal, passes through a pulley (made from a furniture caster) at the top of the box and down to a screw eye in the bottom. A length of cord between the screw eye and the coil spring permits adjustment of the spring tension.

The compression chamber is made of a 4" length of 1" brass tube. In

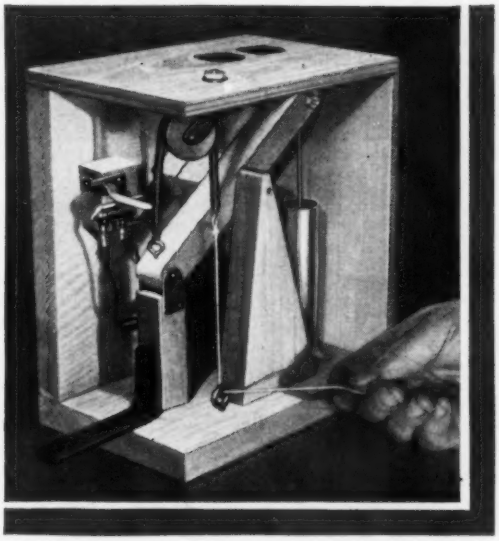


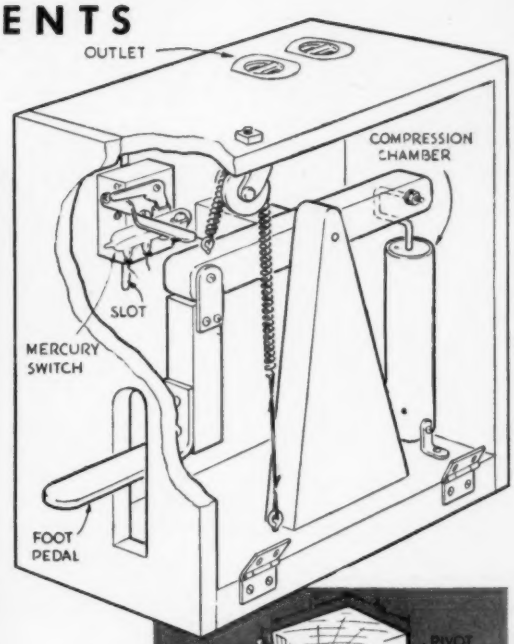
Pressing the pedal turns on the enlarging light, and the switch automatically shuts it off after the proper interval. Left, adjusting the time

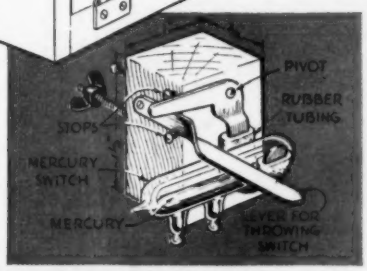
the bottom end is a snugly fitting plug of wood with a 3/16" hole drilled through its center. Over this hole, on the inside, a leather flap is attached with one screw to act as a valve.

The plunger is made of ⅛" brass rod, 6¾" long. With a 6-32 die, thread ½" of one end of the rod and ¼" of the other end. On the ½" thread, screw a 6-32 nut tightly to the end with pliers. Next, slip on a ¾"

TIMES ENLARGEMENTS AUTOMATICALLY



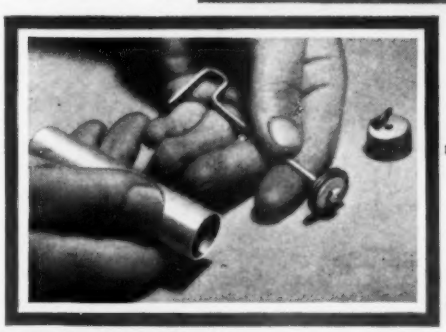


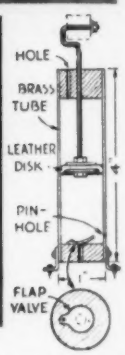


Above, complete mechanism. At left above, adjusting spring. At right, the switch mounting

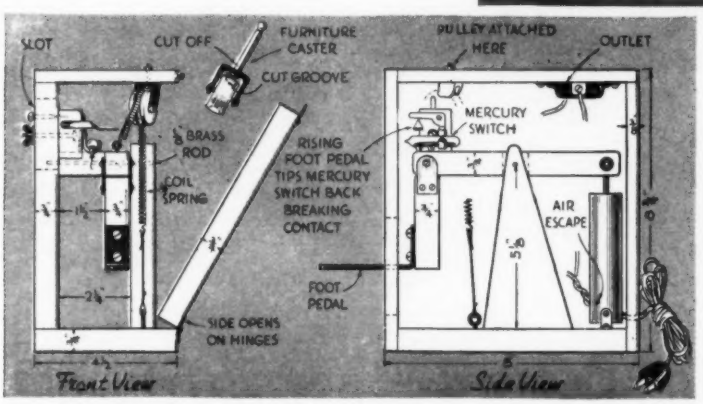
washer, then some 1⅛" disks of leather to average ⅛" thickness, finally another washer, and tighten the whole securely with another nut. Slip the other end through a hole in the center of another wooden plug and bend it as shown in the diagram. Drill a pinhole through the bottom of the brass tube for an air outlet; then insert the plunger and plug. This pump-type compressor is attached to the bottom of the box with two small angle irons in such a manner as to allow it to swing freely.

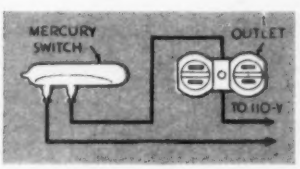
In making the switch, I found that the best type to use is a 2-ampere mercury switch, which cost only 98





The compression chamber and plunger, and a sectional drawing to show them assembled





Left, two views of the switch, in each case with part of the box omitted. Connections are made as in the diagram above

cents. It is an insurance against fire hazards since the arc is inclosed in glass. It also lends itself perfectly to the tilting principle employed to break the current.

The switch is attached to a block of wood 1" by ¾" by 1½", through which a 2" No. 6-32 bolt is passed. A strip of brass, bent to form a "U" around the mercury switch, is covered with rubber tubing to protect the glass. Its other end is a right-angle lever, jutting out past the block. A second lever, attached to the side of the block, crosses under the first lever and extends into the path of the rising foot pedal, which lifts it, tilting the switch and causing the mercury to flow away from the contacts, thus cutting the current.

The block is attached to the wall of the box by the 2" long bolt, which passes through a long slot hole cut vertically in its side. A wing nut tightens it from the outside, and a long roundhead wood screw is passed in through the slot and screwed into the upper part of the block to steady it and act as a pointer for setting the timing.

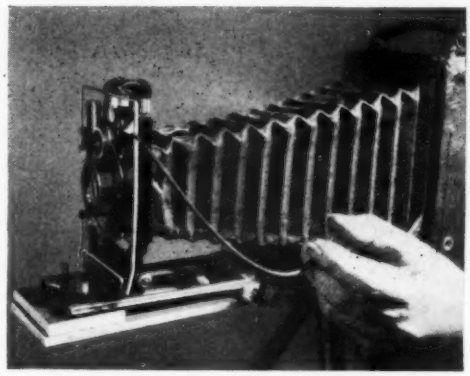
The timing is regulated by raising and lowering the switch and marking off the number of seconds required for the foot pedal to reach it at various positions. A simple manner of timing it is to plug a self-starting electric clock into the outlet and note the number of seconds the second hand travels before it stops.

The front of the box, through which the foot pedal protrudes, should be fastened on with roundhead wood screws to facilitate its removal in case of an emergency, while the right side should be on hinges.

The uses of this foot switch are not limited to the enlarger. It can also be hooked up to the printing box for timing contact prints; and when taking pictures, it can operate the lights for long-time exposures with the camera set on time. One caution should be observed, however: the foot switch must be on a level surface.

Extended Camera Bellows Given Rigid Support

THE elimination of vibration is particularly important when the bellows of a camera has to be fully extended for close-up pictures. To support the extended bed rigidly, a strip of thin plywood or pressed composition wood may be fitted beneath the camera as illustrated at the right. The bed is then blocked up as necessary at the free end. Stiffly reënforced in this way, the camera will have far less tendency to vibrate while the exposure is being made.—E. V. B.



NEGATIVE CONTRAST [*PHOTOGRAPHY*]

These three examples provide a standard of comparison to tell whether a negative has been correctly developed. Underdevelopment is indicated by a thin image and lack of contrast. Overdevelopment is marked by excessive contrast between highlights and shadows.

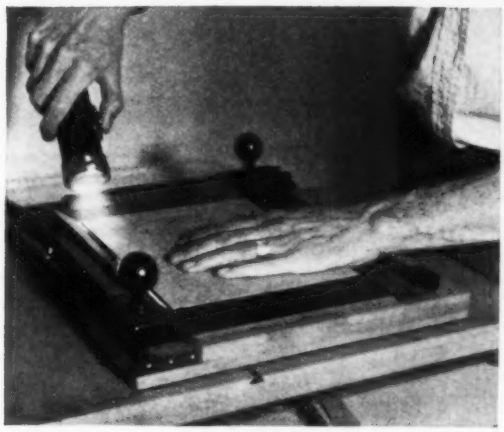
UNDERDEVELOPED NORMAL OVERDEVELOPED

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Printing a Black Border Around an Enlargement

SOMETIMES a photograph has the appearance of running out of its frame. This is particularly true of dense prints or outdoor scenes when it is difficult to print in the sky details. In order to keep the eye from straying outside the picture, a single, thin black border around the picture is most effective.

An easy way to print a black border is to trim a piece of cardboard about ⅛" smaller than the outside of the picture. After the proper exposure has been made, the paper is left on the enlarging easel and the cardboard centered as shown below so as to leave a border. Hold the cardboard firmly in place and play a flash light along the edge of the cardboard.—RAY KERSHNER.



Films Specially Treated in an Illuminated Tray

INTENSIFICATION or reduction of photo negatives is more easily controlled if the negatives are treated in a glass dish supported over a light globe. Every detail is then brought out by the transmitted light. Rest the tray on wooden cleats over which a sheet of white paper has been laid to diffuse the light from a 25-watt lamp.

NEGATIVE EXPOSURE [*PHOTOGRAPHY*]

Use the examples below as a means of comparison to determine if a negative has been correctly exposed. Underexposure is marked by lack of detail in the shadows. Overexposure is indicated by overall detail and flatness.

UNDEREXPOSED

NORMAL

OVEREXPOSED

POPULAR SCIENCE MONTHLY SHOP DATA FILE

THE EXPERT'S

PRINTING

How to Make Dry Points

PART THREE

Wiping the plate with the tarlatan pad. This is done after the surplus ink has been removed with a mosquito-netting pad until the image starts to show

BEFORE preparing your plate to print a dry point, make certain that the adjustments on the press are correct. The pressure must be evenly distributed throughout the length of the roller. To test this, place two or three sheets of blotting paper between the rollers and lay the plate on the traveling bed with the blotters covering the plate. Run the whole in for a short distance; then back it out and examine the impression made in the blotters. If this impression is not sufficiently pronounced, tighten both screws or adjust as necessary. Excessive pressure is not needed for good printing. Replace the face blotter with another one.

Take the paper upon which you desire to print and immerse it in plain water for twenty minutes or longer, depending upon the sizing. When ready to print, remove the paper and place it between two sheets of blotter, drying all the surplus water from the surface.

Place upon a piece of glass some etchers' ink and mull it back and forth with the ink paddle or a palette knife. Remove any lumps or hard particles. If the ink is too stiff, add plate oil a few drops at a time, constantly mulling it until the desired consistency is

INK DABBER. Place the materials as shown above and, if desired, use a piece of chamois to face the finished dabber. Tie it off with half hitches

Steps in folding the tarlatan pad. First rumple the cloth well; then continue folding in the corners until a ball is formed without any loose ends, as below

METHOD OF

DRY POINTS

By
ARTHUR PAUL SNADER

reached. Generally speaking, a dry point will require a slightly oilier ink than would be used with a straight etching.

Make the dabber as shown in the drawings. Next fold a piece of tarlatan until it forms a ball with no loose ends. It is an excellent idea to prepare another of these pads from common mosquito netting for removing the first surplus of ink. Another pad is also needed; it is a piece of cheesecloth, which may be much smaller, and is folded in a similar manner. Rags charged with ink should be kept in air-tight containers to protect them from dust and to prevent the ink on the muslin from drying and becoming hard.

With the dabber, dip lightly into the ink and transfer it to the surface of the plate by a slightly rocking motion so as to roll and press the ink into the lines. Do not scrub with or twist the dabber. When the plate is completely covered, stroke off the surplus ink with the mosquito-netting pad. Do not use too great a pressure, and take your time.

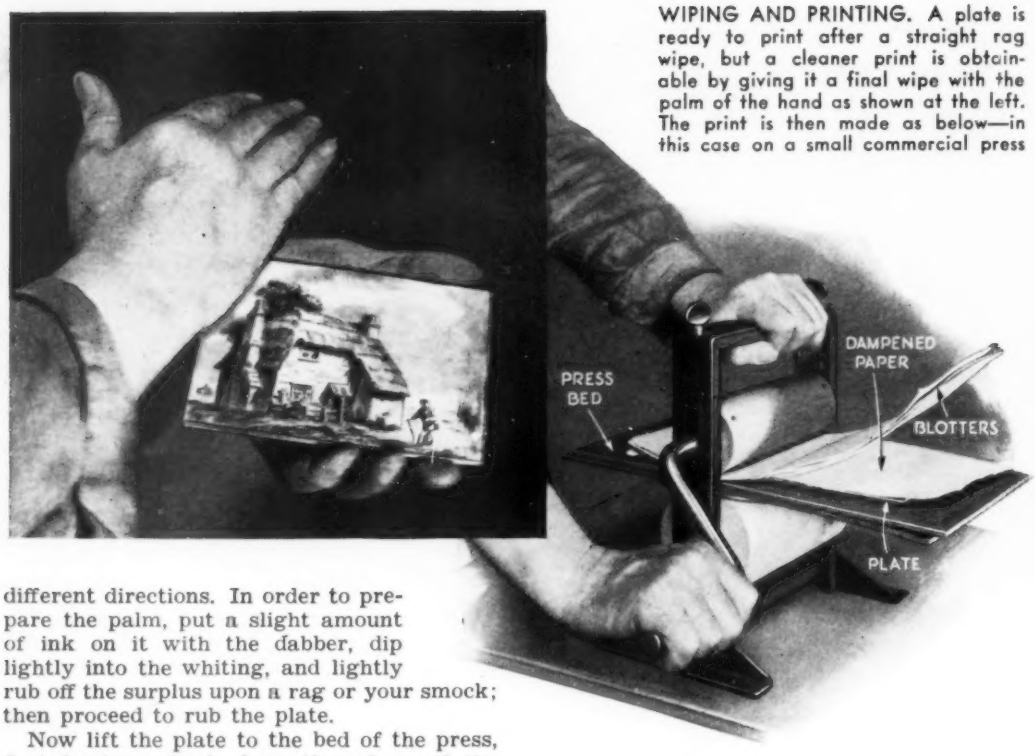
When the image is visible through the ink, begin wiping with the tarlatan pad. Grasp this pad firmly in the hand (not with just the fingers), bring it into contact with the plate at one of the lower corners, bend the hand slightly backward upon the wrist and push the pad before you, describing small circles at an angle of about 45 degrees to the plate. The effect of this is alternately to increase and decrease the pressure as the pad is pushed forward across the plate. Do not expect to make this movement correctly the first time, but persistent practice will bring success. If the movement has been properly performed, the ink will be reduced very gradually and very evenly.

When the plate has been wiped down to expose the image to the degree desired, the circular wiping may be continued with a movement parallel to the plate. In finishing, use the soft cloth or cheesecloth in a similar manner to remove any spots of ink. If you desire to print with a straight rag wipe, you are now ready to proceed with the next step. If, however, you desire to get a cleaner or less "toney" print, you may use the palm of the hand to wipe the plate in a similar manner with a circular movement parallel to the plate and also with a sweeping motion in

WHAT YOU NEED TO MAKE A PRINT

Tube of etchers' ink (a mixture of French black is desirable) and a small quantity of "plate oil" (burned linseed oil) from an art supply shop.
Printers' muslins—plain mosquito netting, tarlatan, and lintless cheesecloth—from any department store.
Block of magnesia from the druggist or ½ lb. whiting from a paint store.
Small quantity of turpentine for cleaning up.
Palette knife or wooden mustard paddle to mull the ink.
Piece of glass upon which to mix the ink.
Some etchers' printing paper. Art supply houses can advise on the different brands. Common correspondence paper, water-color paper, and other papers will also serve the purpose.
Several sheets of plain blotting paper.
Upholsterers' curled hair (enough to half fill a teacup), surgical cotton 4" square, piece of heavy cardboard, and two pieces silk or flannelette 10" square for making a dabber.

Ink is applied to the plate with a slightly rocking motion of the dabber



WIPING AND PRINTING. A plate is ready to print after a straight rag wipe, but a cleaner print is obtainable by giving it a final wipe with the palm of the hand as shown at the left. The print is then made as below—in this case on a small commercial press

different directions. In order to prepare the palm, put a slight amount of ink on it with the dabber, dip lightly into the whiting, and lightly rub off the surplus upon a rag or your smock; then proceed to rub the plate.

Now lift the plate to the bed of the press, first having wiped clean the edges of the plate. Place the dampened paper over it and lay the press blankets or blotters on top. Grasp the cross bar of the press with your left hand, the handle with your right hand, and turn slowly and evenly until the plate and dampened paper are completely through the rollers. Lift the blotters and slowly draw your print from the plate. Do not peel it—lift it.

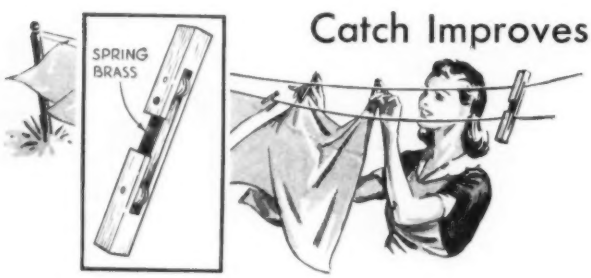
To prevent the damp print from shrinking, attach it to corrugated cardboard with gummed tape. This is called "strain drying." The paper will usually dry in about an hour.

Thoroughly clean the plate with turpentine, benzine, or carbon tetrachloride. Facial tissues are excellent for drying. Do this immediately before the ink dries in the lines.

A rag very lightly charged with ink is called a "thin" rag; one heavily charged with ink is a "fat" rag. The latter makes a better print because it leaves a more perfect tone, but a thin rag is useful in finishing a wipe where less tone is desired.

If your first attempt should be an unqualified success, you would be by way of setting some kind of world's record. There are so many little things which require the knack that comes of practice alone. Do not attempt to get an "etched" line as on a visiting card. That is another and more involved story. The cardinal virtues of an etcher are patience, persistence, and order. Patiently prepare and persistently pursue an orderly course of action and you cannot fail.

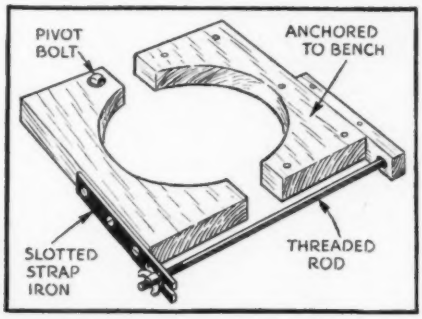
Catch Improves Clothesline Spreader



This spreader stays in place on even the windiest days

A WOODEN clothesline spreader of the type illustrated will sometimes drop from the line on windy days, necessitating a trip to retrieve it. This can be prevented by riveting a piece of spring brass over the opening. The spreader then slips on the line readily, but can be removed only by pressing the spring inward and sliding the line out.—S. J. GANCHER.

Wooden Clamp Holds Ice-Cream Freezer Securely



The two parts of the clamp are cut to fit the freezer, and a threaded rod with a wing nut provides pressure

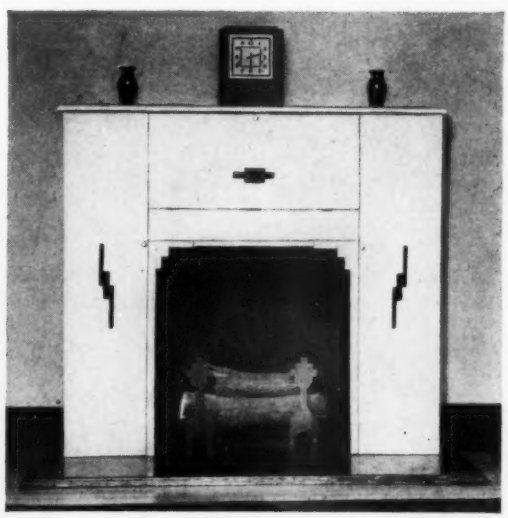
WHETHER an ice-cream freezer is turned by hand or motor, a substantial clamp made as shown will improve its operation. There will be no more dancing around of the entire outfit when the cream begins to stiffen.

Two pieces of wood are sawed to a radius equal to that of the bottom of the bucket, outside. One piece is fastened to the bench or table top; the other is pivoted at one end, and this piece has a slotted length of strap iron screwed to the free end to receive the clamping rod. A clearance of an inch or two is left between the two pieces when in the closed position.

The freezer used by the writer is driven by a belt through a slot in the table top, and an old washing-machine reducing gear serves to gear down the speed.—C.A.V.

Modernistic Fireplace Opens to Reveal a Small Bar

FOR the small apartment or house where space is at a premium, a combination fireplace and bar may be constructed by anyone who can use a hammer and saw at a cost of approximately five dollars. The one illustrated was built from clear white pine 1" thick. The hearth is made from a piece of pressed composition wood, and the same material is used as a back, which is then covered with an appropriate wall paper. The top door swings down to make a handy serving shelf. The decorations on the front are pieces of large dowels, cut in half and painted a contrasting color.—J. S. BARDWELL.



The fireplace as it normally appears and, at left, how its compartments are arranged for use as a bar

WE GET OUR Cabin Cruiser READY TO LAUNCH

By WILLARD CRANDALL

PART FOUR

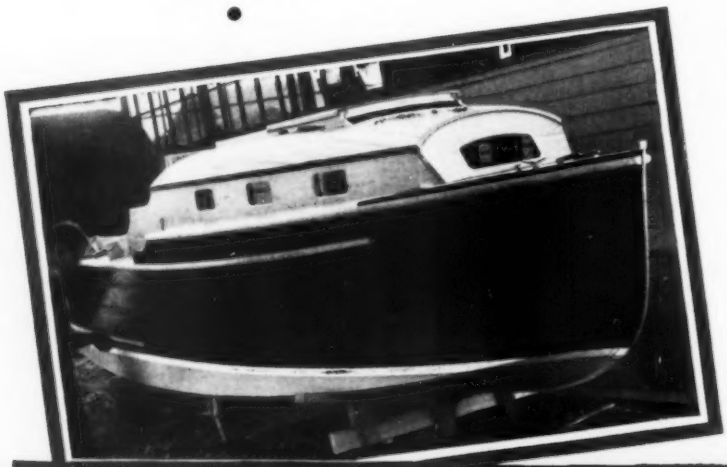
THE motor hatch is made so that it can be lifted off to remove the motor. The curve of its beams is the same as the transom top. The cabin hatch should be made approximately as shown in previous drawings. It will slide forward on oak rails fitted to the cabin top. These rails can serve also as handrails.

Make the rail around the forward end of the deck—the chock rail—of ⅞" oak cut to shape, rather than attempt to bend it into place. The mooring chocks will be screwed to it, placed as shown, and the mooring cleat is placed in the center of the forward deck, bolted through the center deck batten. Two small cleats may also be used near the stern.

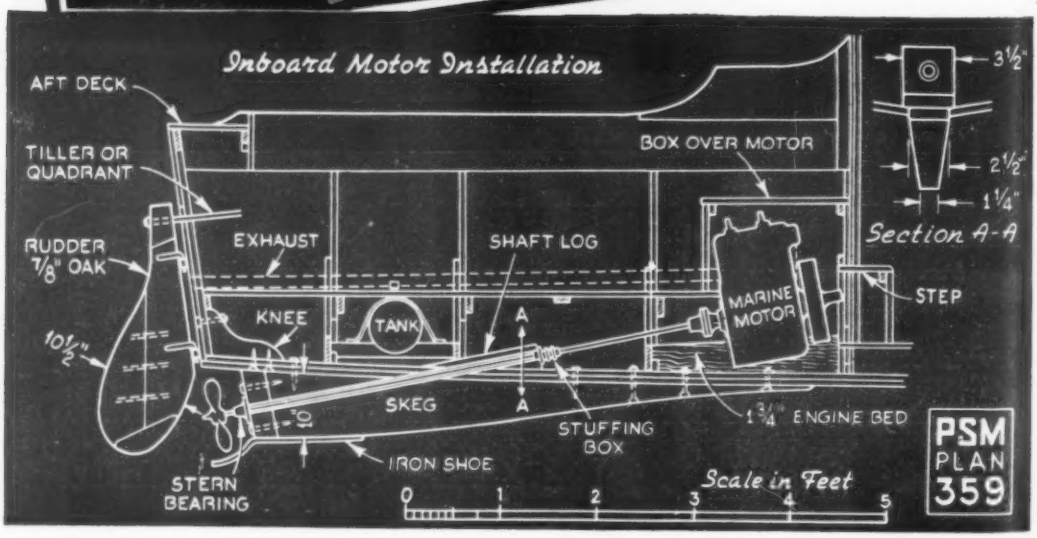
Now screw the fender and sheer molding to the frames with 1½" No. 8 oval-head screws; put it on carefully so as to insure a perfect curve fore-and-aft of the sheer and deck lines. Pieces of batten material may be used for trim at the top of the cabin sides. A strip of half-oval brass or galvanized iron should be used to protect the stem.

Windows in the sides of the cabin should be cut as shown in the drawings, but the window in front is optional. The front of the cabin may be made removable if desired.

The steering wheel should be of the regulation marine type, mounted on the bulkhead and bolted to a block on the inside. Run the tiller lines to a double block under the coaming and back to a second



Fender and sheer moldings must be put on carefully, as at the left, to insure a perfect curve



Roomy as the cruiser is, it may easily be carried long distances on a light trailer

The motor, in this case a small outboard, is well protected, yet readily accessible. A motor from 2½ to 10 h.p. is recommended

double block opposite the steering handle. One line will then go directly to the steering handle while the other crosses the boat to a single block and back to the handle. A spring used in the tiller line will prevent slack. The same arrangement can be used with an inboard motor, except that the tiller arm or quadrant will take the place of the steering handle. Folding chairs may be used in the cockpit, or seats arranged as desired.

The entire outside of the hull should be well sanded before painting, and all screw holes covered with putty after the priming coat is dry. The water line should be carefully trued up with a long batten and then may be permanently marked on the planking. If the boat is to be used in salt water, the bottom below the water line should be painted with copper paint; otherwise any good marine paint may be used. The sides may be finished with marine enamel, or with flat paint covered with spar varnish; the rest of the hull can be finished as desired.

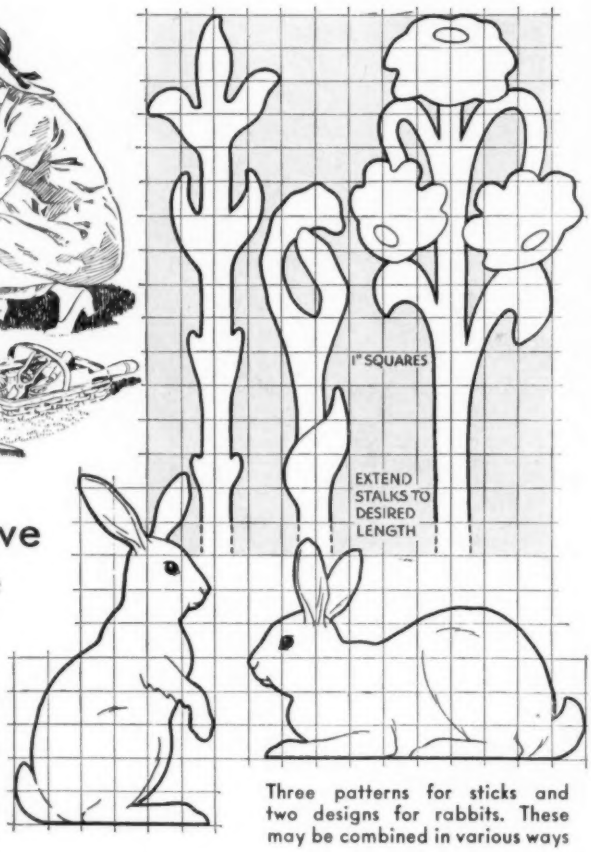
If an inboard motor is to be used, install engine beds, preferably of oak, between stations Nos. 5 and 6; fasten with lag screws to frames and floor ties. Use marine glue and cotton flannelette between the shaft log and the keelson. Fasten the skeg and the shaft log to the keel and keelson with bolts and lag screws. Bore the hole for the shaft through

all—the shaft log, keelson, keel, and skeg.

The box over the motor should be placed against the bulkhead, and the bottom of the door into the cabin must be high enough to clear it. When an air-cooled motor is used, the box should be removed while running. If a gas tank of 5-gal. capacity or less is used, it may be installed just under the back deck, high enough for gravity feed. The size of the shaft, stuffing box, and stern bearing will depend on the motor used; propeller size recommendations may be obtained from the motor manufacturer. The motor should be finally lined up and coupled to the shaft only after the boat has been in the water for a day or more.

Most builders will wish to install a red-and-green light on the bow, and a white light on the stern. Such lights are required by law if the boat is to be operated at night on navigable waters. While some inland waters are not classed as navigable, in general most waters this cruiser is suited for are; and it is well to see that, besides being fitted with lights, other requirements of the U. S. Government are complied with before the boat is launched.

Chief of these requirements are: a whistle and approved life preservers and fire extinguisher to be carried aboard at all times; the boat to be registered and the assigned number painted on, or affixed to, the bow. Full details of the federal requirements, which always apply when the boat is operated on navigable waters that do not lie wholly within one state, may be obtained from the Department of Commerce, Washington, D.C.



Three patterns for sticks and two designs for rabbits. These may be combined in various ways

Unique Plant Sticks Have Bunnies at Their Base

ALTHOUGH the construction of plant sticks is one of the most popular projects, especially among those who own a power-driven scroll saw, the designs almost always run along the same lines—usually a cut-out bird on a stick. Here is a variation from those conventional designs. The sticks themselves are cut out in plantlike patterns, and at the base a jig-sawed rabbit is used. To provide for ample variety, three stick patterns are shown and two rabbits. These may be used in any combination.

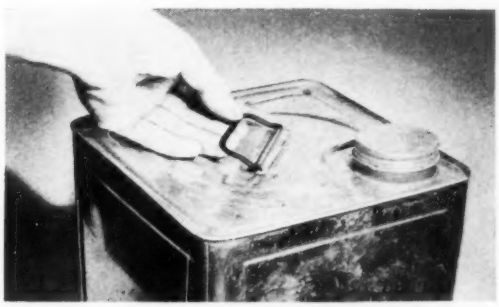
The sticks may be extended at their lower ends to any length, and extra leaf shapes may be added if desired. About 8" should be allowed for the pointed end that is to be pushed into the ground. Draw the designs full size and mark them on the wood.

White pine ⅞" thick is a durable material to use. A natural tan rabbit with a green stick gives an attractive effect. White or any bright color may be chosen for the flowers, and white or black might be used for the rabbits.—HAZEL F. SHOWALTER.

Glue Solution Cleans Enameled Surfaces

ENAMELED woodwork, walls, and other enameled surfaces can be cleaned with glue water. Simply add a tablespoonful of ordinary ground glue to each quart of boiling water and stir until the glue is dissolved. The mixture may be used lukewarm or cold. Dip a soft, absorbent cloth in the glue water, wring it out nearly dry, and wipe over the enameled surface once. No soap or other cleaning agent is required. The solution, if not rinsed off, dries with a glossy finish. The dirt and grease vanish as if by magic. The glue water is not harmful to any enameled surface.

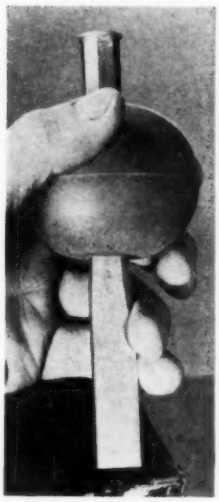
The mixture will keep for a time and may be used as a kind of spot remover. For example, finger prints may be removed from a door without washing the entire door.—C.S.



Kink in Wire Can Handle Helps in Grasping It

LARGE cans often have wire handles that fall flush with the top, and it is difficult to get one's finger underneath, especially if wearing gloves. To overcome this annoyance, simply bend the handle slightly at each end in opposite directions, as shown above. This can be done in an instant by using two small wrenches to kink the wire.—B.N.

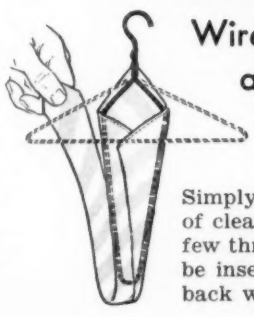
Rubber Ball Gives Better Grip on Cold Chisel



COLD chisels and steel punches can be gripped more readily if they are fitted with a sponge-rubber ball as illustrated at the left. The ball, which is of the type sold as a toy, is drilled and slipped on the tool. The hole should be fairly small so that the ball will fit the handle of the tool snugly, without any tendency to slide up and down. It will be found that the ball not only provides a larger surface to grasp, but also absorbs much of the shock.

Removing Hard Scale from Old Pewter

THE hard scale that discolors old pewter may be loosened in a hot bath of any very strong alkali household cleanser or lye, then scoured off with powdered pumice stone applied with a brush.

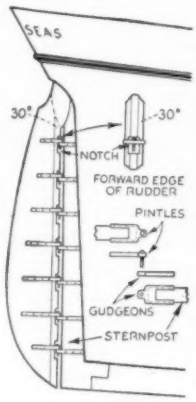


Wire Forms Used in Cleaning and Stretching Neckties

NECKTIES can be cleaned and stretched over forms made by bending wire coat hangers as shown. Simply pull each tie over a form, apply plenty of cleaning fluid, and hang it up to dry. If a few threads have to be cut so the hanger may be inserted, fasten the ends of the tie at the back wih a small safety pin.—M. C. RESEK.

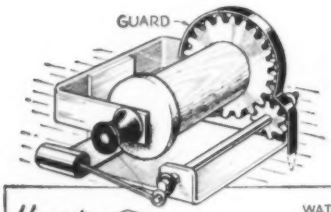
A Cargo Winch

AND OTHER SHIP MODEL HINTS

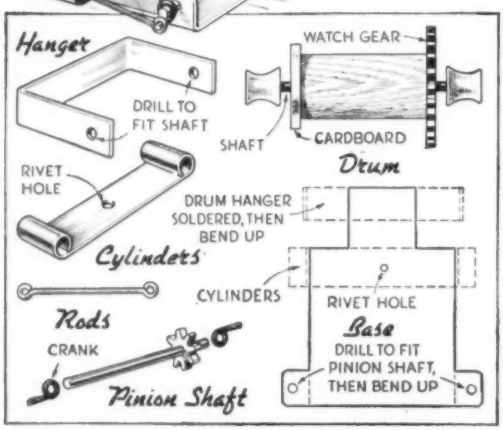


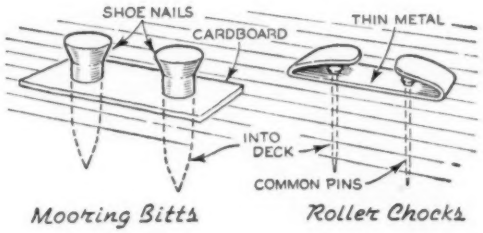
WORKMANLIKE, smoothly acting pintles and gudgeons may be made as shown from 1/16" thick brass. If the rudder is 3/16" thick, for example, make them 7/32" wide so they project 1/64" on each side of the rudder. Then notch the rudder 1/32" deep on each side so the pintle or gudgeon, which has a rectangular opening 1/8" wide cut in it, can slide into place. Make the pintle pin from a 1/2" gimp tack.—GERALD E. BAKER.

A CARGO winch for a ship model can be made as shown below by pressing or soldering gears from an old watch on wire shafts. The cylinder piece is riveted to the base with a common pin. The drum hanger is sweated to the tab on the base, and then the whole is bent up. The wooden drum is then inserted, also the pinion shaft. A crank is soldered at each end of the pinion shaft, and the snubbing drums, filed or turned from metal, are mounted on the drum shaft. The connecting rods are set in place and the crank ends are flattened. The gears are brought into mesh by bending the drum support. The guard is attached after the winch has been mounted.

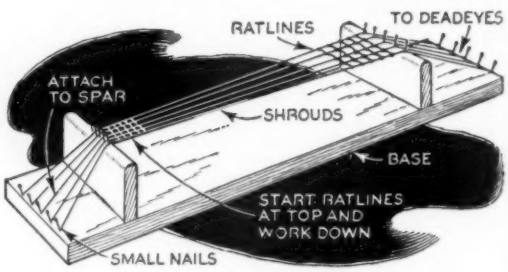


Dimensions depend on the gear diameters. Paint the cylinders, drums, hangers, and rods black





MOORING bitts and roller chocks may be made by the simple method illustrated. I used fittings of this type successfully on a 27" model tramp steamer.—ROBERT LAHAINE.



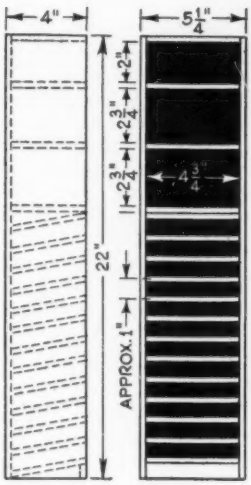
A CONVENIENT way to make standing rigging for a ship model is on a stretcher. Dimensions depend upon the model, of course. Long ends are left with which to tie in the deadeyes and for fastening the rigging to the spar through and above the crosstrees. It is then much easier to weave the ratlines* through the shrouds—H. E. STALKER.

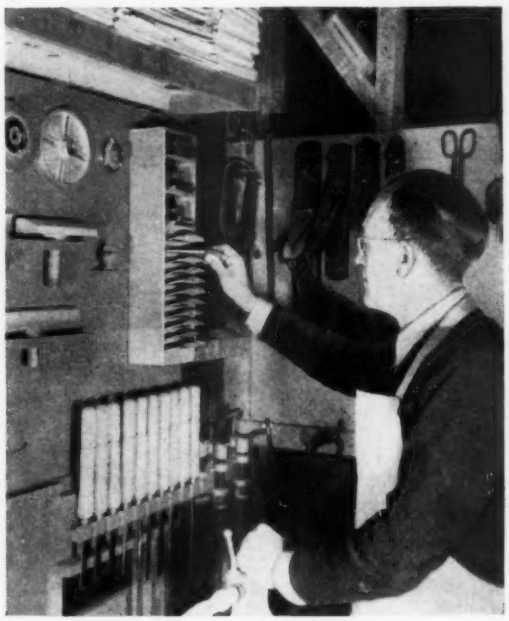
* For information on applying ratlines and other hints, see Chap. IV, "Manual of Ship Model Making," (Popular Science Publishing Co., Inc., New York, price $1.00).

Sandpaper Sheets Kept Neatly in Small Cabinet

CRAFTSMEN who take pride in the neatness of their shops can provide a place for storing sandpaper by building a cabinet like that illustrated. It has small slanting compartments for a number of different grades of sandpaper, as well as space for two sanding blocks and a division to hold steel wool.

Plywood ¼" thick is satisfactory for the cabinet. The shelves are cut 4¾" wide and 4⅜" deep and nailed in as shown with 1" brads; then they are dressed flush with the face of the cabinet. Cutting the shelves may be simplified by the use of a gauge for the circular saw. Cut the usual 9" by 11" sandpaper into four pieces to fit the cabinet, and number the shelves to correspond to the grade of paper.—F.H.



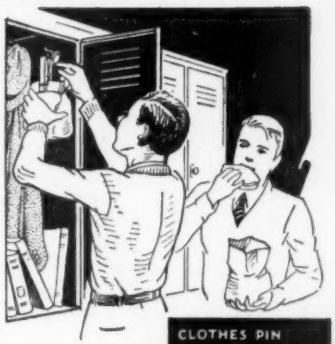


The shelves, which hold quarter sheets of sandpaper, slope towards the back as shown at left

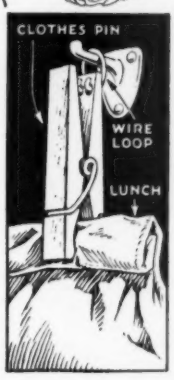
Simple Way to Make Coin Holders

A COIN holder for mailing small amounts of cash may be quickly made with scissors from a piece of light, thin corrugated cardboard of the type used in small cartons. Cut square openings in the board slightly smaller than the coins to be inserted, as shown; then push back the corrugated material slightly with the tip of the scissors so the coins may be inserted. One advantage of this holder is that the coins cannot jump out of it when in the envelope; also, no adhesive is required.—ALBERT BUIVIDAS.

Lunch Hangs from Clothespin in Overcrowded Locker



HIGH school students who carry their lunches often find that the paper bags or packages get in the way of their books and papers when placed in the overcrowded lockers. A good solution is to drill two holes side by side in the top of an ordinary spring wooden clothespin as shown and insert a wire loop so that the clothespin may be hung on a hook. The lunch is then suspended by means of the clothespin, and is consequently at the top of the locker, out of the way at all times.—CLARENCE NEHER.



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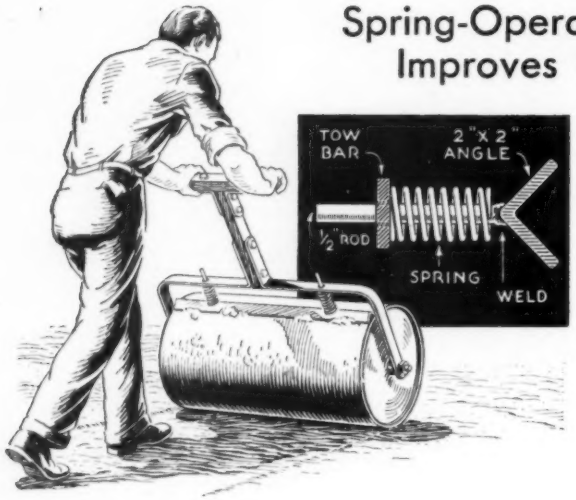
Spring-Operated Scraper Attachment Improves Ordinary Lawn Roller



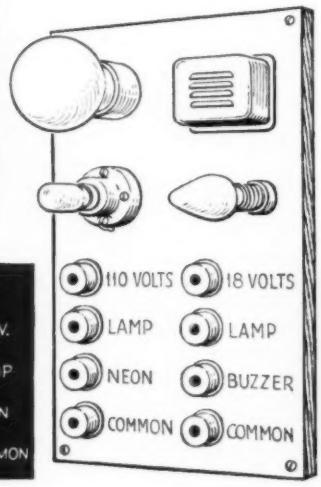
BY THE addition of a spring scraper attachment like that shown, a lawn roller may be kept free from mud when rolling moist earth, regardless of the direction of travel. A piece of 2″ by 2″ angle of about the same length as the roller will serve as the scraper. It is mounted on the frame by means of two short pieces of ½″ steel rod and two automotive valve springs. Have the guide rods welded to the heel of the angle, and assemble on the tow bar through two holes. Washers may be added, if necessary, for adjusting the spring tension as desired.—LESTER J. KING.

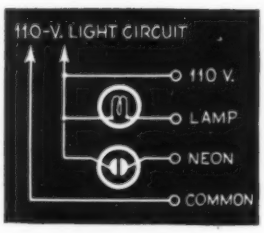
Test Panel Aids in Repairing Electrical Devices

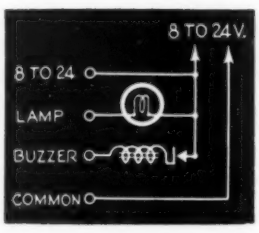
IN MOST home workshops it is necessary occasionally to test electrical devices. Rather than rummage through your electrical equipment and set up a temporary circuit, you can make a small, compact test board.

The one illustrated is of 4½″ by 8″ by ⅛″ hard fiber, but hard rubber, composition, or well-shellacked ¼″ plywood will do as well. Place it where both the lighting circuit (110 volts) and your bell ringing transformer (8 to 24 volts) are available. The materials needed, in addition to the panel, are a standard lamp socket, two midget sockets, relay from junked auto generator, neon lamp, Christmas-tree lamp, eight radio tip jacks, two radio test prongs and cord tips, and the wire for connections.

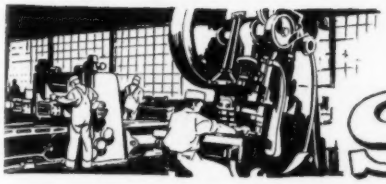
The wiring diagram provides high and low voltage, whether direct or at high or low current drainage. For example, the 110-volt circuit has a neon lamp that passes almost no current; next you have a lamp in series, and by changing the lamp voltage you can vary from 1/10 to 3 amperes. For more current, you can obtain a heating coil, that will give you 6 amperes. On the low-voltage side, the Christmas-tree lamp is low current, but the buzzer (the old relay) gives heavy current.— E. J. H.





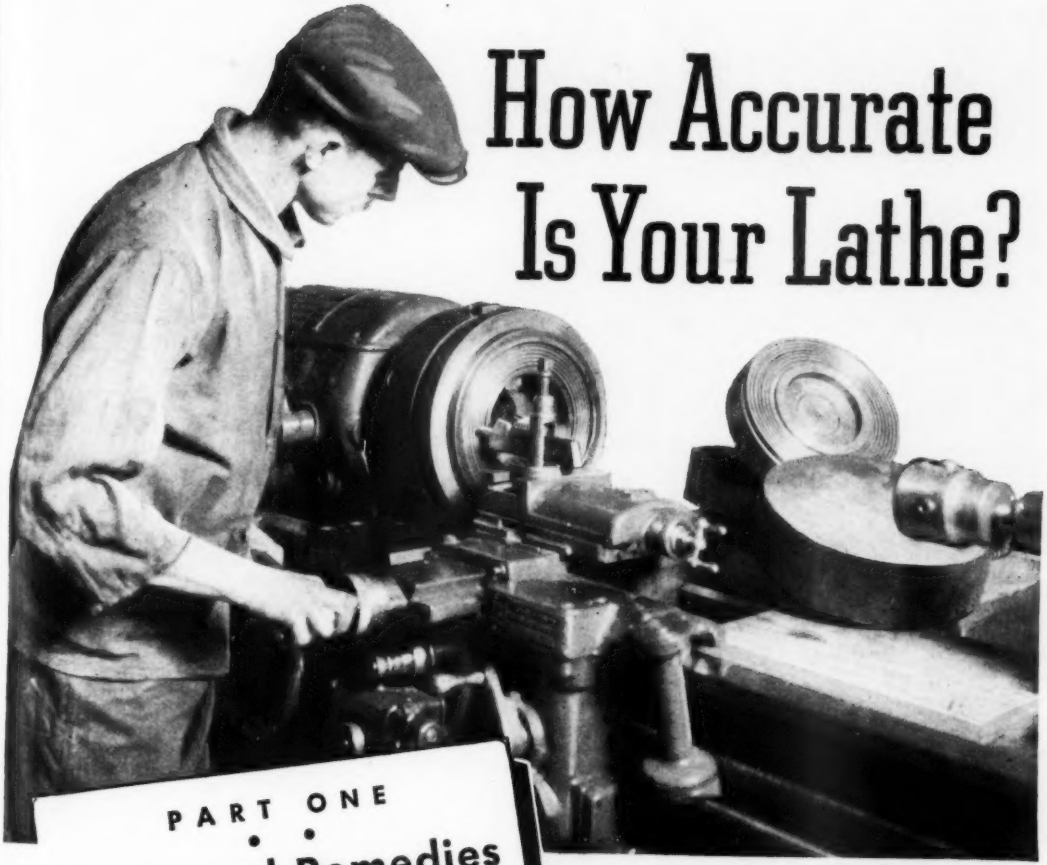


In testing with this panel, always begin with the low-current drain and work up. Use the Christmas-tree lamp for low voltages, the neon lamp for high voltages



NEW SHOP IDEAS

How Accurate Is Your Lathe?



No matter how well trained and attentive a lathe operator may be, he can do good work only if his machine is accurately adjusted

PART ONE

Tests and Remedies for Spindle Wear and Misalignment

THE error of regarding a metal-cutting lathe too much as if it were a roughing tool is often made. The fact that a certain piece has to be finished by grinding does not relieve the lathe operator of any responsibility in respect to his drawing or dimensions. Allowing either an excessive or an insufficient amount of stock may prove costly at times.

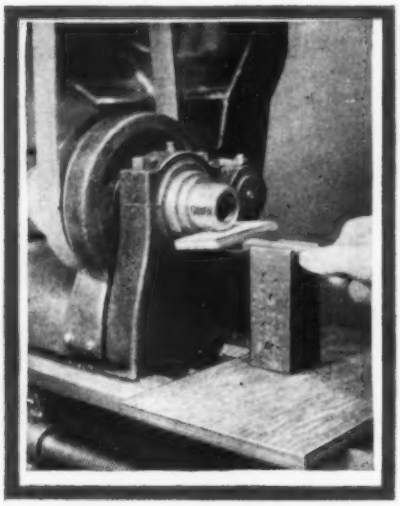
Obviously, the condition of the machine and its accessories has much to do with production results as a whole. A two-year apprentice can do better work with a good lathe than a full-fledged graduate with one that's "all shot." Even an artist in his line

By W. C. CHENEY and H. J. CHAMBERLAND

can accomplish little if he works with hay-wire equipment.

A true lathe hand keeps his machine well lubricated and well brushed up at all times, and this has much to do with his output. He is particularly attentive to the components of the cross-feed mechanism where chips accumulate rapidly.

Of course, the headstock bearings take the severest punishment, particularly the front bearing. The latter has to resist the bulk of the thrust due to pressure from drills feeding into the work and also the thrust due to pressure from the turning tools feeding against the work. The latter pressure is the more serious and is the cause of much chattering and also tapered work.



The lathe spindle is pried up gently to test for possible wear. Note the small block used to protect the threads

If your lathe is causing trouble, you can usually restore its accuracy by the following methods:

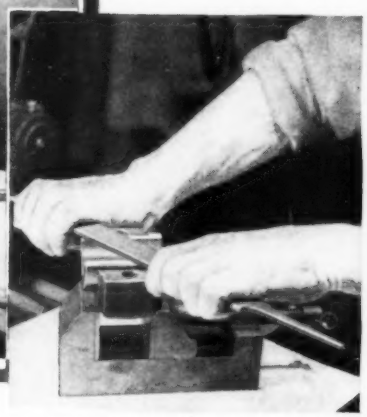
Brush the lathe thoroughly from top to bottom, dig all chips out from hard-to-reach places, give it a kerosene bath, and wipe thoroughly. If you make a practice of using an air jet, don't do it in this particular case and you will save time in the long run.

With no chuck or faceplate on the spindle, take an easy pry on the end of the spindle by using a board across the ways, a block, a bar, and another small piece of wood to protect the spindle threads, as shown in one of the photographs. If you find no play with this test, fill the bearing oil cup and repeat the test. A minimum amount of wear will be indicated by the oil's rising and falling in the cup. The same procedure is followed for both bearings.

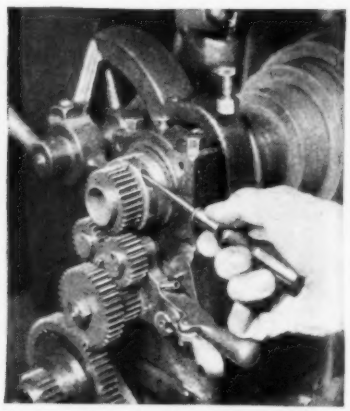
If adjustments have to be made, start with the front bearing by removing the cap and marking so that it may be replaced in its original position. Do not be alarmed at slight ridges on the journal and extending the full length of the bearing; these result from the fact that a lathe spindle has to operate without end play. The next move is to hold the bearing cap in a vise and evenly file off a slight amount to bring the required fit. If shims have previously been used as frequently happens, they will, of course, have to be stepped down.

You can now replace the

The front bearing cap and the headstock are marked with chalk so the cap can be replaced without difficulty in the proper position



The bearing cap is placed in the vise and filed evenly and cautiously to compensate for wear. The fit is then tested



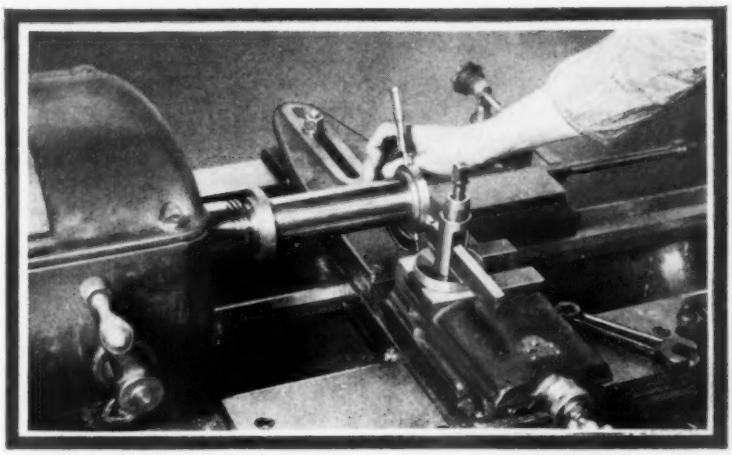
To compensate for end play, the lock screw of the take-up collar is loosened and the collar turned until the spindle drags slightly

cap and repeat the original test. When you are satisfied with these results, take up the rear bearing in the same way if it needs it. Whatever you do, never remove the bushings from their housings or shim under or along the sides. All bearing components must fit tightly together. Don't attempt to make adjustments with tension on the cap screws.

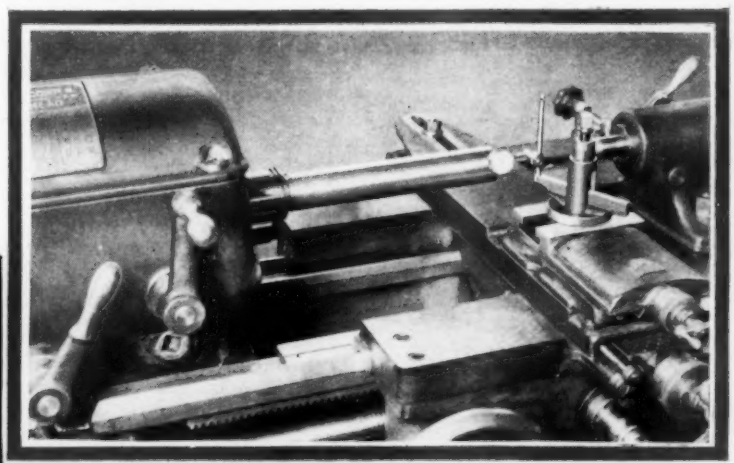
The next step is to remove all end play from the spindle. The conventional construction of a lathe allows for a take-up collar, which is threaded to the spindle. Loosen the lock screw and turn the collar slightly against the bearing until a light drag is felt when revolving the spindle, as shown in one of the photographs. Then lock the collar. The question is now to determine if the work already done has really restored the lathe's accuracy from that angle.

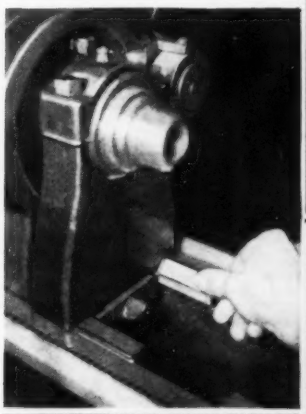
The first test is that of spindle alignment for turning and boring. The bar should have a testing length of 8"; the diameter should be from 2" to 2½"; and it should be recessed as shown. The shank should be a perfect fit in the spindle bore and preferably be ground. The test consists of taking a light finishing cut at both ends of the bar with the same tool-depth setting. A variation not exceeding 0.001" indicates satisfactory accuracy.

The second test is for spindle alignment in

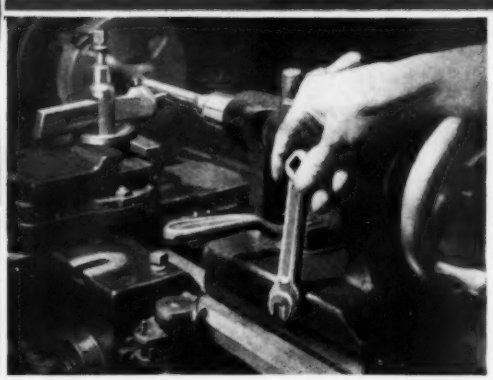


Spindle alignment is tested with a recessed bar. Identical finishing cuts are made at each end, and the variation should not exceed 0.001"





Shimming the vee of the lathe bed to compensate for wear at the rear of the front bearing resulting from tool pressure



In addition to making the turning test, it is necessary to check the horizontal alignment of the spindle with a dial indicator as illustrated above. A similar test is then required for vertical alignment. At left, making transverse adjustments to tailstock until a centered piece turns straight

both vertical and horizontal planes. For the horizontal test the bar should have a 10″ to 12″ testing length and a diameter of 1¾″ to 2″. As in the previous case, it is fitted to the spindle bore. It should be precisely straight and concentric and therefore preferably ground all over. A variation not exceeding 0.001″ proves that the spindle is in satisfactory alignment with the bed vees.

The vertical test is identical except that the dial indicator is adjusted radially with the top of the bar—in other words, the opposite plane. Leave the indicator in the latter position and operate the spindle at its lowest possible speed. This will give you the spindle run-out test. The 0.001″ allowance is good for all tests and is close enough.

You may assume that you have previously done a fine job if all these tests prove satisfactory; if not, you must recheck the bearings. Any difficulty is likely to be found in the front bearing. This wear results chiefly from the pressure of the turning tool and is on the side away from the operator. Slacken off the clamps holding the headstock to the bed, pry up the headstock, and shim the inner surface of the inner vee. Tin foil is recommended for shims. Draw the headstock down tightly before making further tests.

When you are satisfied that you have corrected all trouble in the headstock, it is necessary to find out how it lines up with the tailstock. First comes the tailstock-center height test for which you should again use the 12″ bar or one similarly finished. The test is similar to that for vertical alignment, but of course the bar is tailstock-centered. Long-continued or extensive friction between bottom of tailstock and bed must eventually result in more or less wear, thus causing the tailstock to be lower than its mate. This trouble can be economically remedied by gradually spraying the tailstock bottom with some metallic compound. Uneven spots may be removed after being located on the bed with Prussian blue or red lead.

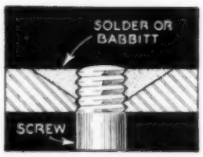
The final test is that of turning a piece on centers and bringing the tailstock in line by the usual method.

(To Be Continued)

Hand-Drill Knob Extended to Prevent Fatigue

When it is necessary to drill holes of comparatively large diameter with a small hand drill, much effort must be exerted. It is particularly hard on the right hand, which tends to become cramped holding the small knob with which the large gear is turned. This fatigue may be prevented if a short length of pipe is slipped over the knob, providing a better grip.

Worn Threads Built Up with Solder

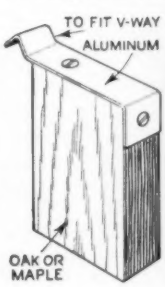


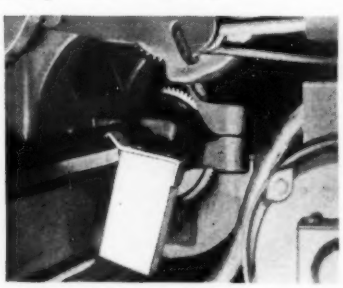
Stripped internal threads replaced by countersinking and flowing in solder

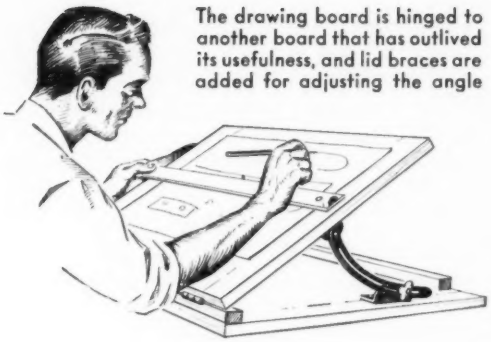
When internal threads on small parts are stripped and it is not possible to retap for a larger screw, a good repair can be made as shown. The hole is countersunk with the point of a large twist drill or a regular countersink. The screw is then heated and supported in position. Apply flux to the hole only, and pour hard solder, type metal, or babbitt around the screw. Smooth the surface with a file. The threads thus formed are surprisingly strong, and the screw may be removed and replaced many times.—R. C. R.

Chuck-Loosening Block Kept Handy on Lathe

Instead of having to hunt for a piece of wood every time it is necessary to loosen a tight lathe faceplate or chuck, you can keep a special block available by the method shown. Cut a piece of oak or maple and fasten a strip of sheet aluminum to one edge. Bend the projecting end of the strip so the block can be hung on the V-way behind the headstock. In loosening a faceplate or chuck, let it strike the aluminum at the end opposite the V.—B. K.







The drawing board is hinged to another board that has outlived its usefulness, and lid braces are added for adjusting the angle

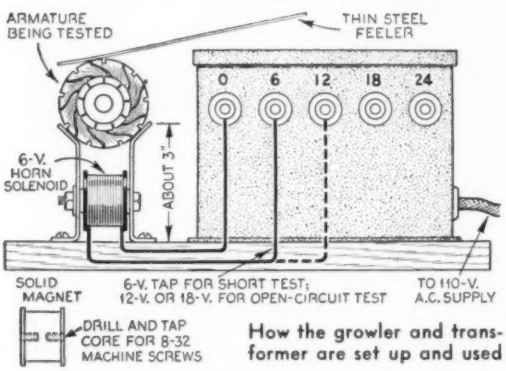
Lid Braces Regulate Angle of Small Drawing Board

MOUNTED as illustrated above, a small drawing board may be readily adjusted. A pair of hinges and lid braces, two small angle pieces, two ¼"-20 bolts, and two wing nuts are the only hardware required. For the base, the writer used a discarded drawing board. Front and back cleats were added to provide clearance for the swinging braces.

V-Block Made from Two Lead-Filled Pipes

RUGGED, inexpensive V-blocks for the bench or drill-press table can be made from short pieces of pipe, discarded piston pins, or even large bearing rollers. Two such pipes or tubes of the same length are required for each V-block. Stuff paper wadding tightly in one end, then clamp them side by side, vertically, in the vise. Insert a U-shaped steel wire or rod in the top opening and fill them with molten lead or solder. When cool, reverse the pieces, pull out the wadding, and repeat the operation, using another bent rod to tie the ends securely together.

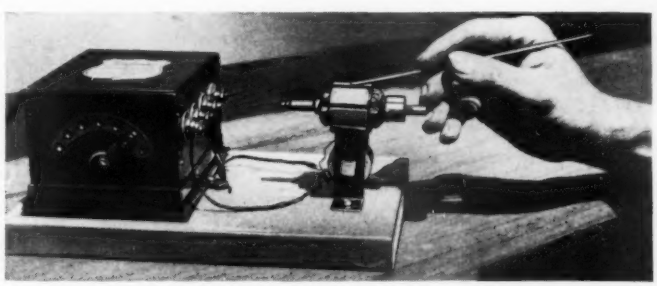
Small Armatures Tested on a Miniature Growler



How the growler and transformer are set up and used

WHEN diminutive armatures from horn motors, commutator-type fans, and other very small motor-driven appliances have to be tested, the regular growler used on the electrical test bench is generally too large. A growler for this purpose can, however, be made as shown. Its basis is a solenoid taken from an auto horn of the vibrator type, although good results may also be obtained by using the magnet from an old generator cut-out or a low-voltage relay magnet. If a magnet with a solid core is used, the ends must be drilled and tapped for iron machine screws. The legs are made from soft strap iron. Mount the assembled unit on a board large enough to accommodate a toy train transformer or a large doorbell transformer.

In testing for shorts in the armature windings, the growler coil may be connected to the 6-volt tap on the transformer. A thin steel feeler is then held over the armature as it is turned slowly by hand. A shorted coil is indicated by a pull on the feeler. In testing for open circuits, use the 12- or 18-volt tap and apply the feeler so as to short adjacent commutator bars. When no spark is obtained, a broken or open coil is indicated. Grounds are detected by using test prods and lamp, although they have not been incorporated in the growler illustrated since those on the regular full-size growler can be used for this purpose—W.C.W.



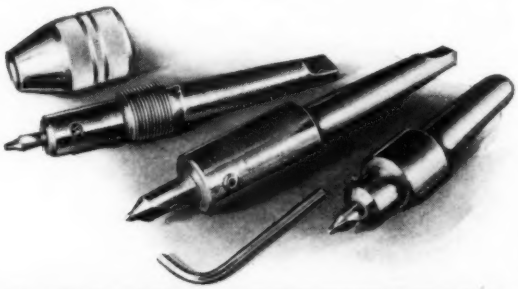
An inexpensive, quickly made branding iron for permanently marking wooden tool handles

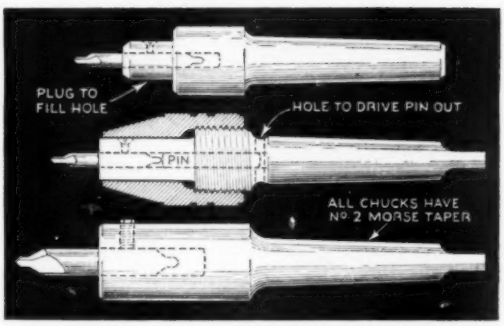
Branding Iron for Wood Has Welded Letters

A BRANDING iron is frequently useful for permanently marking company initials, serial numbers, trade-marks, dates, and other information on tool handles, timbers, cases, and heavy wooden products. One may be inexpensively made from a piece of bar steel about 1" thick and of sufficient area to receive the desired outlines. First lay out the design in reverse, using chalk or soapstone, and center punch for better visibility. Then have a welder lay on a neat, high bead, using a fairly cold flame or arc so as to raise the outline. If done carefully, very little chisel finishing is required. When completed, attach a long handle of steel rod to the bar piece by welding.—L.J.K.

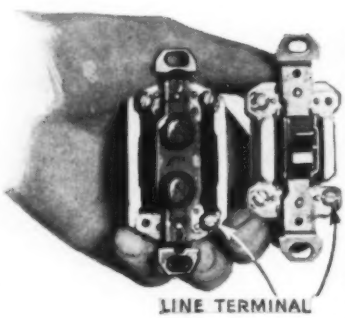
Making Individual Chucks to Hold Center Drills

THE convenience of having three center drills of different sizes always handy in their individual chucks is well worth the time it takes to make the chucks. Discarded tools with No. 2 Morse taper shanks were used for making the chucks illustrated. They are always ready for use in the lathe tailstock and save much time in rechucking the center drills.—CHESTER W. WOODSON.





REPLACING WALL SWITCHES [ELECTRICAL]



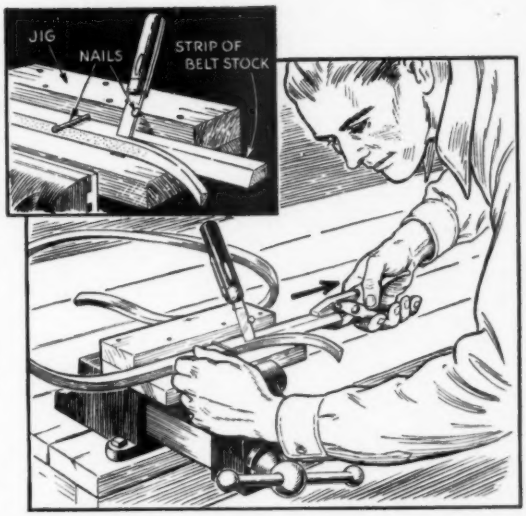
Wall switches of the old-style push-button type should be replaced, when worn out, with the modern toggle type. Remove the plate, after shutting off the current, and loosen the two 6-32 machine screws that hold the switch to the box. Disconnect the wires and insert the new switch by reversing the operations. In the case of a three-way hall switch, the line or feed wire must be correctly connected. It is the wire connected to that terminal of the old switch which has a strap connecting it to the other side of the switch, where it will be seen a screw has been omitted. The other two terminals are for the other wires or "travelers." A new switch plate will, of course, be required.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Small V-Belts Prepared from Leather Trimmings

WITH a simple jig made from two small pieces of wood as illustrated, any mechanic can prepare leather V-belts in a variety of sizes to meet special requirements. Note that the pocketknife is kept from working loose by a shingle nail driven into the upper corner of the top board. Another longer nail is driven horizontally into the edge of the top board to keep the leather from buckling. After the belt has been beveled along one side, turn it end for end with the beveled side against the top board, reset the knife to cut the desired width, and bevel the other side.

Scrap stock for small belts, of the finest leather obtainable, may often be purchased by the pound from belt manufacturers. The so-called "trimmings" average from 1/8" to 3/16" in thickness, from 3/8" to 5/8" or 3/4" in width, and from 30" to 3' or 4' in length. Stock for small belts of any needed size may be built up by cementing pieces together. I find that they often outlast belts costing several dollars.—R. G. BULLARD.

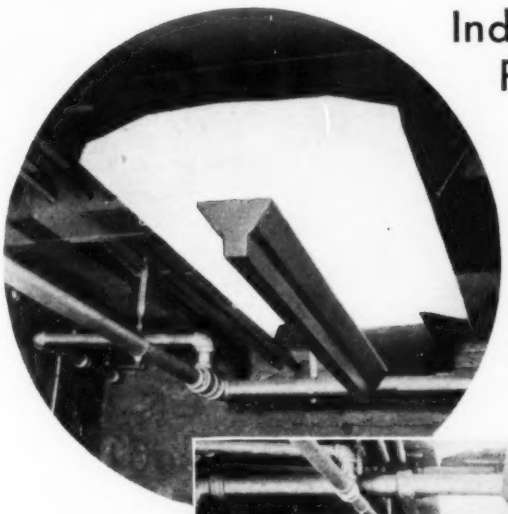


A jig for cutting small, accurately beveled V-belts

Indirect Lighting Fixtures Prevent Shadows in Shop

TWO homemade indirect lighting fixtures, each 6' long, illuminate the small machine shop illustrated so evenly to the very corners that it is impossible for a person to get in his own shadow. This aids greatly in laying out and machining work accurately. The illumination is far superior to that obtained with ordinary shaded droplights, which give an undesirable glare.

The top hood of each fixture was bent from a large sheet of galvanized iron to the proper angle for maximum reflection and held in shape by metal straps fastened with stove bolts. The bottom trough, which holds the light sockets, was bent to shape in a sheet-metal shop. The trough was then suspended about 20" below the canopy, and four 200-watt lamps were installed after the inside of the trough and underside of the canopy had been painted with a good grade of glossy white paint to aid the reflection. —RAY BLAIN.



The hood is of galvanized iron, and four 200-watt lamps are placed in the trough below it

Two fixtures of this type light the shop shown at the right so uniformly that all troublesome glare and shadows are avoided

Improvised "spade" removes shingles without splitting

Homemade Tool for Lifting Old Wooden Shingles

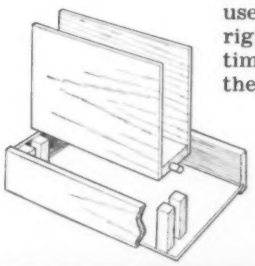
TO REMOVE wooden shingles from a roof, various spadelike devices are used, but one can be made by fastening any heavy piece of scrap sheet iron to a handle. Few of the shingles will be split if the tool is handled with reasonable care.—NORVAL WRIGHT.

Varnish Imitates Ground Glass

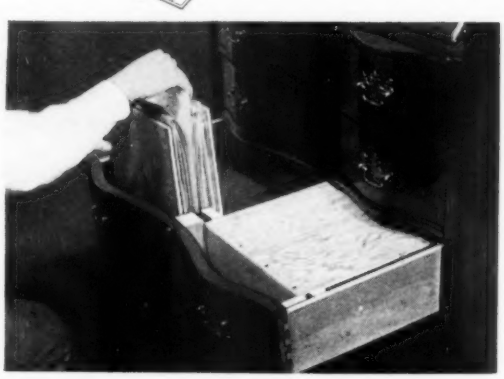
GLASS may be given a ground-glass effect with a varnish mixed as follows: gum sandarac 2¼ oz., gum mastic ½ oz., ether 24 oz., and benzol from 6 to 18 oz.

Small Letter File Folds into Drawer of Desk

A LETTER file that folds compactly into a desk drawer is a handy addition, especially where no separate filing cabinet is available. The one illustrated below is made of two pieces of thin plywood fastened to a bottom piece of ⅞" wood. Dowel pins are inserted in each end of the bottom to slide in slots built into the drawer. In use, the file stands upright, while at other times it folds back into the drawer.—G.R.B.

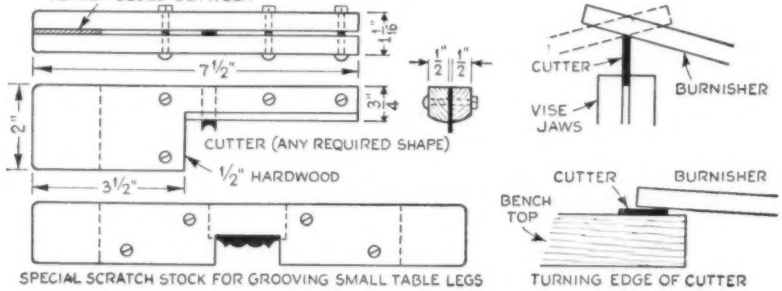


How the files are made and, below, two of them placed in a desk drawer



SCRATCH STOCK [WOODWORK]

This scratch stock is useful for cutting beads, small moldings, inlay grooves, etc., by hand. The cutter may be made from a broken hack-saw blade. The cutting edge is ground square with the sides, smoothed with oilstones, and then turned with a burnisher. First rub the burnisher over the edge, then over both sides (or just the reverse of the method used for a hand scraper).



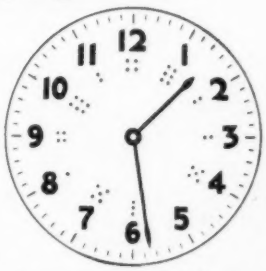
SPECIAL SCRATCH STOCK FOR GROOVING SMALL TABLE LEGS

TURNING EDGE OF CUTTER

POPULAR SCIENCE MONTHLY SHOP DATA FILE

Marked Watch Dial Used in Mystifying Trick

YOU can amaze your friends by offering to tell them offhand on what day of the week any date will fall this year. Suppose, for example, that you are asked what day September 17, 1939, will be? You reply, "Just let me look at my watch and I'll tell you." After glancing at your watch, you say it will fall on Sunday.



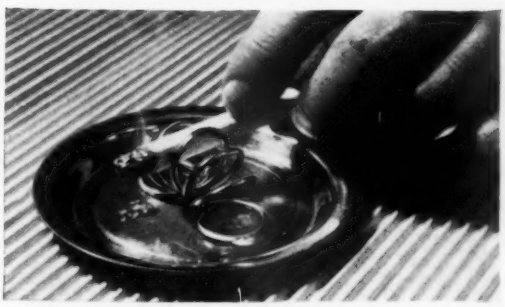
Arrangement of dots on the watch dial or crystal for finding 1939 dates

The secret lies in the preparation of the watch dial. Small dots must be marked on the dial as shown. Each number on the dial represents a month, so if the date is in September, the ninth month, you look at figure 9 and note that there are four dots beside it. Add this number to the date (4 plus 17=21) and divide by seven (the number of days in a week). If there is no remainder, as in this example, the date will fall on a Sunday. If there is a remainder, one means Monday, two Tuesday, three Wednesday, four Thursday, and so on.

For instance, what day is July 8? July is the seventh month with five points on the dial, so 5 plus 8=13 which, divided by 7, gives 1 and a remainder of 6. That means the sixth day of the week or Saturday. Bear in mind, however, that the arrangement of dots is for the year 1939 only, so restrict all inquiries to this year.

Cigarette Extinguisher Added to Ash Tray

SHALLOW metal ash trays of the type shown, which can be obtained for five cents, are much more useful when a cigarette-holding attachment is added. Wind seven turns of stiff wire on a $\frac{5}{8}$" dowel or mandrel, then spread them so that one side of each turn is $\frac{3}{8}$" from its neighbor. Solder the end turns to the bottom of the ash tray. A lighted cigarette left in one of the four spaces will automatically become extinguished when the fire reaches the wire, or the ash and fire can be removed by drawing the end of the cigarette between two turns.



An ordinary metal ash tray may be improved by adding a coil of wire to serve as a cigarette snuffer

Baffle Prevents Water Splashing from Sink

WHEN vegetables are cleaned at the kitchen sink or other work done that requires running water, the water can be prevented from splashing out at an angle by using a baffle bent from a strip of 2" wide sheet brass as shown.—B. B.

New Wheel for Vacuum Cleaner

BECAUSE of long, hard usage, the rear wheel on our vacuum sweeper became so worn it had to be replaced. I removed it and attached in its place a ball-bearing roller skate wheel. Over the wheel I stretched a $\frac{5}{8}$" section of radiator hose to prevent the floors from being marred. The wheel was much cheaper than a new wheel.—BENJAMIN NIELSEN.

Snail's Tool Kit

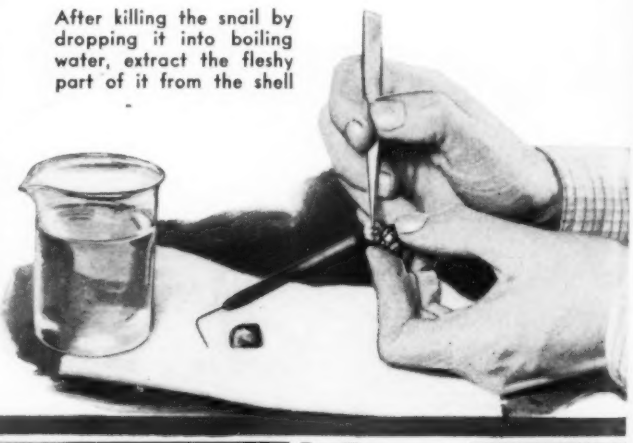
SHOWN BY YOUR MICROSCOPE

DID you ever watch a garage mechanic repairing a car-fender or body dent? After pounding the metal as smooth as possible, he fills with solder the depressions that he cannot iron out. Then he takes a coarse-toothed rasp or file and smooths the solder until its surface is continuous with the rest of the metal, so that under the lacquer or enamel subsequently applied the damaged spot does not show.

A remarkable tool, that rasp the mechanic uses, and handy to have in any workshop. But if you think it's something of fairly recent origin, and a tool that human ingenuity first produced, you are jumping the gun a bit. The lowly snail has been using such a rasp for countless centuries, for the simple purpose of grinding its food into small particles that it can digest without getting a stomach ache; and an abdominal pain probably would be specially inconvenient to a snail, since it walks on its stomach. And so again we find that nature beat man by some millions of years in the developing of a highly useful tool that does its job with marvelous efficiency

The snail's rasp, which is in reality its tongue, and which goes by such other names as "radula" and "lingual ribbon," is one of the most fascinating and beautiful of objects that the amateur microscopist can examine through his magic lenses. It is important, too, from a scientific standpoint, because it is an essential means of identifying snails. Unfortunately, the snail has to be killed before its identity can be established by examining the tongue with a microscope.

If you extract a snail from its shell, pin it



After killing the snail by dropping it into boiling water, extract the fleshy part of it from the shell

Boil the body in a caustic solution to dissolve fleshy tissues, leaving the tongue

The specimen is stained by introducing a few drops of suitable dye, as illustrated above

After rinsing to remove dye, the tongue is easily seen and can be taken out of the tube

At the right, drying solution is being removed from a slide by means of a blotter. The photomicrograph shows the tongue of the familiar Japanese snail

to a cork block weighted with lead beneath a shallow layer of water or alcohol, and dissect the snail with sharp scissors, needles, and scalpels, you will discover, at the extreme front end of the head upon cutting it open, an oval formation. This is the snail's buccal mass, or cheek, and consists of the radula, the jaw, and muscular tissue for operating these instruments.

Since the radula and jaw are made of chitin, a horny substance that is not affected by strong alkali, it is a relatively simple matter to separate the tongue and jaws from the fleshy parts. After you have dissected out the buccal mass, place it for a few hours in a strong solution of potassium hydroxide (caustic potash). You can use sodium hydroxide, or ordinary lye, instead, but longer time is required. The alkali dissolves away the fleshy tissues and leaves the radula and jaw clean and intact. You can then wash them to remove the alkali, and transfer to a drop of water on a slide, for examination.

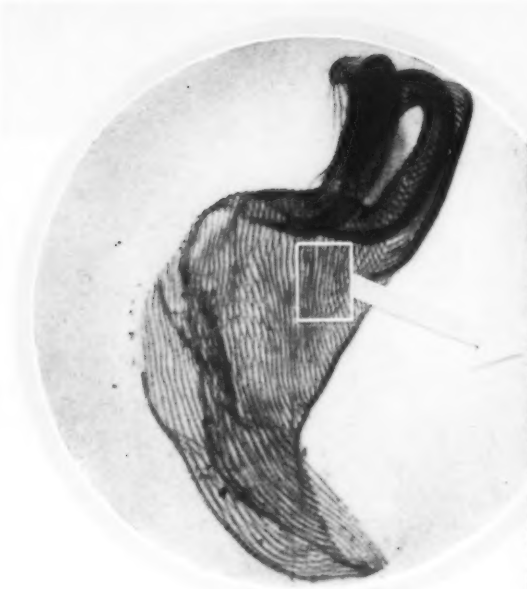
Handle the alkali very carefully, and keep it off your skin and clothes, for it is highly damaging. The way it dissolves the fleshy parts of the snail should be sufficient warning to you in the protection of your own flesh.

Since you are interested at the moment in the snail's tongue and not in the other parts of its anatomy, such as shell structure, no matter how interesting they are, you probably will prefer to extract your specimens in a more direct way, and eliminate the necessity of dissecting.

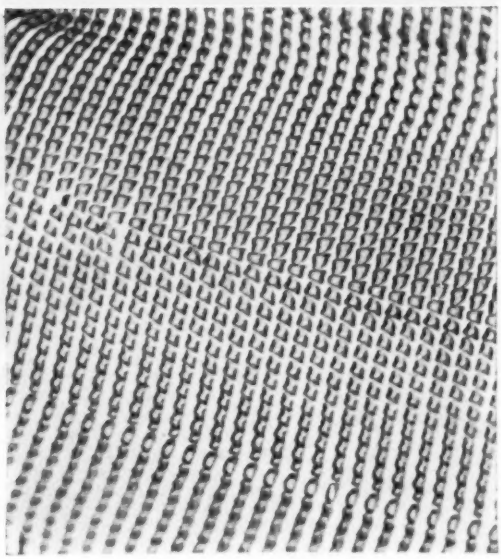
Let's begin at the beginning. First you must have snails. Reference to a good biology text will show that there are numerous sizes and shapes and kinds of them scattered over the world. You will learn that the snails are called gastropods because they walk on their stomachs; that some live in water while others are land dwellers; that some of the water snails have gills and can stay under water indefinitely, while others have to come to the surface periodically for air; that some shells coil upward in a vertical plane while others coil horizontally; that some snails have a horny trapdoor called the operculum to close their shells after they have retreated inside.

You will have no trouble finding snails. Any pet store that handles aquarium supplies will sell them to you. In warm weather, you can collect them in almost any stream or pond of water. Whether you buy or collect snails, get one or two of each kind or family, including if possible the large *Viviparidae* commonly called Japanese snails. Although you can find lingual ribbons in very tiny snails, it is much easier to work at first with large specimens.

By
MORTON C. WALLING



This is the rasp with which a snail grinds its food. Below is a section, further magnified, of the tongue seen at the left. Note the filelike teeth arranged in orderly rows



Bring a beaker or tin can of water to a boil, and drop the snails into it. This may seem heartless, but you've got to kill them somehow, and the hot-bath method is that used in most laboratories. Remove the snail from the water after a half minute or so, let it cool, and with tweezers, curved needles, or hooks made from safety pins, extract the fleshy part from the shell. Usually this slips out quite easily. If you want to keep the shell, clean it thoroughly to remove any flesh and mucus that may cling to it, and lay it aside to dry.

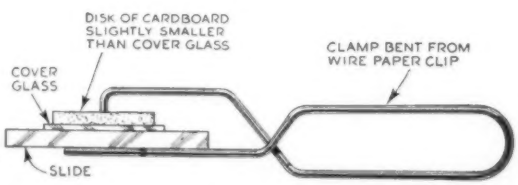
Make a strong solution of potassium hydroxide in a beaker or test tube. You can buy the dry alkali at a drug store or chemical house in the form of sticks or pellets, and dissolve it in water. Handle the dry pieces with tweezers, not your fingers unless you wear rubber gloves.

Drop the entire snail into the alkali solution, and set it aside until the fleshy parts have dissolved completely. This may take several hours or a day. You can speed up the process by heating the alkali until it boils. The fleshy tissue will then dissolve in a minute or less.

CAUTION: Heat and otherwise handle the alkali very carefully. If you are not accustomed to boiling things in glass beakers, flasks, or test tubes, use a granite cup or pan, which eliminates the possibility of breakage. If you use a test tube, keep its mouth turned *away from your face*, and heat it slowly by bringing the Bunsen burner or alcohol lamp up to it gradually, or holding the glass in the flame for but a few seconds at a time at first. And when the boiling point is almost reached, remove the flame, and then apply it again very carefully, for the solution has a tendency to shoot out of the tube with the sudden generation of steam. Fill the tube only about one eighth full of the alkali solution.

After you have destroyed the fleshy parts with alkali, you may be able to see the snail's tongue at the bottom of the vessel. If you used a granite container, pour the alkali from it into a flask, test tube, or beaker after cooling; rinse the snail's tongue with a little water and pour it into the same beaker. The tongue will appear as a small strip of whitish material that settles to the bottom rapidly.

Very carefully, pour the alkali off into a large beaker or jar half full of water, to dilute it before flushing it down the sink. The lingual ribbon should remain behind. Add fresh water, shake, and let the ribbon settle



This easily made slide clamp will come in handy for pressing cover glasses into place over specimens

to the bottom. Pour off the water, and repeat the rinsing several times, to remove the alkali. This washing is easier to do in a test tube or flask than in a beaker.

Finally, after thorough rinsing, pour out all the water with the exception of eight or ten drops, and introduce, by means of a glass dip tube or pipette, a few drops of stain. Almost any microscopic stain will color the snail tongue, but safranine, hæmatoxylin, and carmine are among the most commonly used. The specimens shown in the accompanying photomicrographs were stained with safranine, which works almost instantly.

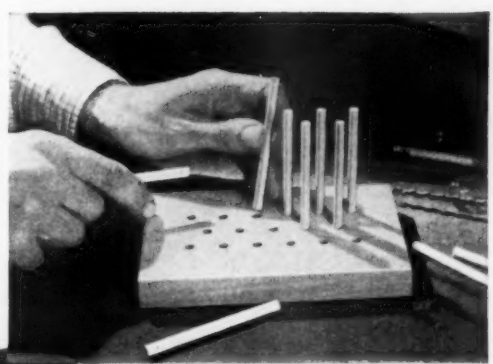
After the lingual ribbon has been stained, it is easy to see. Rinse it in water, lift it out of the test tube with a needle, and transfer it to a clean glass slide, preparatory to mounting permanently in balsam.

There are two ways of treating the specimen before mounting. Since the chitin does not become water-soaked, and is not distorted by alcohol, it can be dried by placing it at once in 95% alcohol for a few seconds, transferring to absolute alcohol, then after a few more seconds, to xylol. All this can be done on the slide, by applying a few drops of the fluid at a time with a dropper, and removing it by draining or touching with the edge of a blotter. Finally drain off the excess xylol, add Canada balsam, and drop the cover glass into place. The tongue should, of course, be spread out on the slide as completely as possible. Some workers recommend that it be cut crosswise in one or two places, to reveal the teeth better.

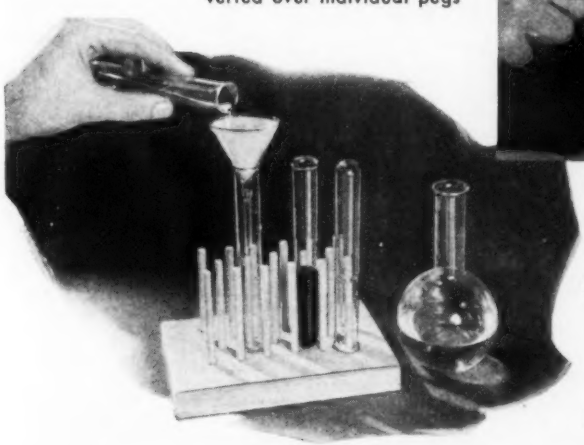
The other way of mounting the radula is to rinse it after staining, and transfer it to a few drops of dioxan on a slide. Drain and treat with fresh dioxan once or twice, and then cover with balsam. In treating with alcohol or dioxan, some of the stain will bleed out, but this does not matter if the staining was sufficiently deep in the first place. It is usually best to apply some pressure to the cover glass while *(Continued on page 236)*

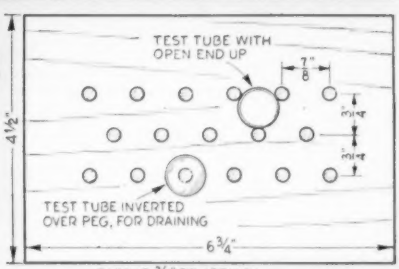
Handy Rack Holds Test Tubes with Either End Up

FOR handling test tubes in preparing microscope subjects, you will find it handy to have a rack that will hold tubes with mouths either up or down. An easily made rack consists of rows of wooden pegs set in holes in a wooden base. Use ¾″ redwood or cypress for the base, and ¼″ maple dowel stock for the pegs. Cut the dowel material into pieces about 4″ long and insert them into holes bored in the base as shown in the diagram. The tubes are held upright between the pegs when they contain liquids, and in an inverted position over the pegs when they are draining after being washed.



When tubes are being used to hold liquids, they are placed between the pegs. For drying, they can be inverted over individual pegs





BASE IS ¾" TO 1" THICK
PEGS ARE ¼" MAPLE DOWEL STOCK

Tests for Home Scientists

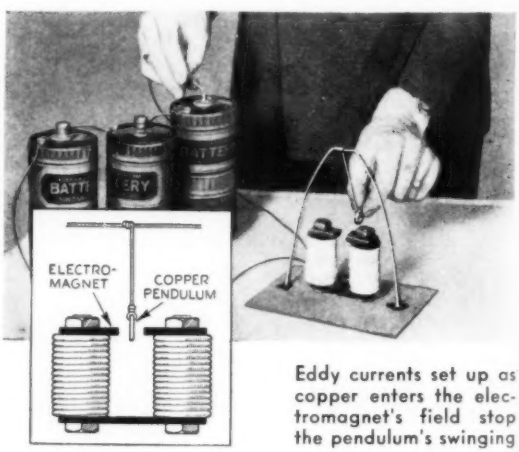
Flame Conducts Electricity

Clicks in phones show flame completes the circuit

A CANDLE flame will conduct electric current, as you can easily demonstrate. Connect several dry cells in series with a pair of radio headphones, as shown in the drawing at the left. Cut the wire on one branch of the circuit, and scrape the insulation from the cut ends, leaving the bare metal exposed. Now place these bare ends, one above the other and an inch or so apart, in the flame of a burning candle. Making and breaking the circuit at one of the battery terminals will produce distinct sounds in the headphones, showing that the current is passing through the flame. Unlike air, which would serve as an effective insulator to prevent the passage of the current from one of the wires to the other, the hot gases and smoke of the candle have enough conductivity to transmit the electricity from the dry cells into the headphones, where it makes a telltale click.

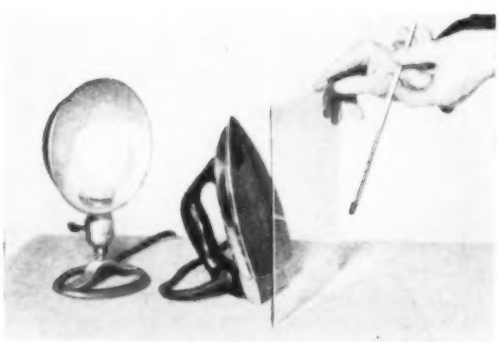
Electromagnet Shows Eddy-Current Effect

SUSPEND a heavy pendulum of copper so that it swings between the pole pieces of a strong double-pole electromagnet. If no current flows through the magnet, and the pendulum is drawn back and released, it will oscillate freely. Now excite the magnet by connecting it to three or four dry cells, and release the pendulum again. Only with difficulty will it swing between the pole pieces. Strong "eddy currents," set up in the copper by induction, produce conflicting lines of magnetic force that retard the movement of the pendulum.



Eddy currents set up as copper enters the electromagnet's field stop the pendulum's swinging

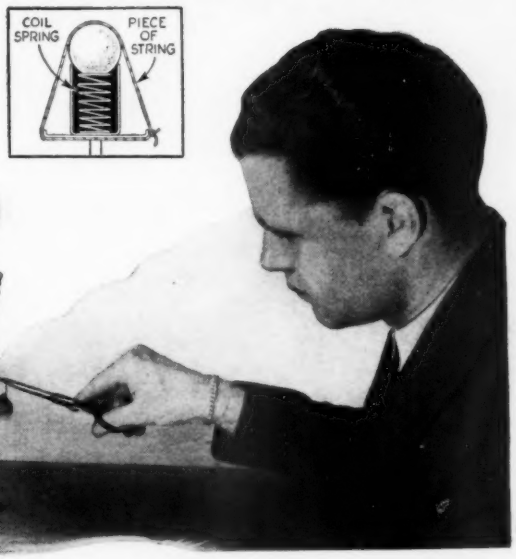
"Short-Wave" Heat Penetrates Glass



GLASS is not equally "transparent" to the various wave lengths of radiant heat, which lie beyond the red end of the visible spectrum. Place a sheet of ordinary glass between a hot flatiron, or a hot radiator, and the bulb of a thermometer. The mercury in the thermometer will not rise. Substitute a lighted electric-lamp bulb as a source of heat, as shown, and the mercury will immediately start ascending. To long heat waves, the glass is virtually a barrier, but the shorter waves emitted by incandescent bodies are readily transmitted. In this experiment, the filament of the lamp bulb emits waves of the latter type.

Here's What Happens When a Gun Kicks

COMPRESS a coil spring in a small cylindrical container, add a solid rubber ball as a lid, and tie down the combination with a string to the plate of a small spring balance. Cut or burn the string. As the ball is hurled upward, the spring will press downward with equal force upon the scale, which will register momentarily several ounces of increased weight.

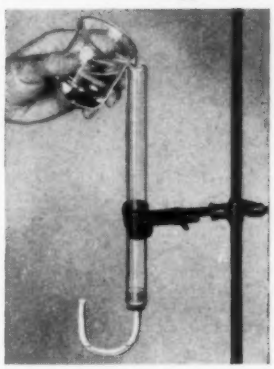


Trick Illustrates Surface Tension

WITH a glass tube or medicine dropper, place some olive oil in an alcohol-and-water mixture. If the oil floats, add more alcohol; if it sinks, more water. When the alcohol-water mixture has the same specific gravity as the oil, the latter will come to rest midway between top and bottom, in the form of a sphere. Its surface tension pulls it into the shape that has the least surface for its volume.

Do Vapors Have Weight?

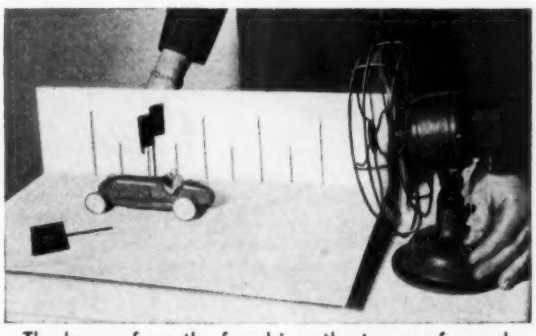
CONNECT a U tube to the lower end of a vertical section of glass tubing, making an air-tight joint with a one-hole stopper. Place a little water in the U tube. Tilt a beaker containing carbon tetrachloride as shown, so that vapor from the volatile liquid—but not the liquid itself—will pour into the vertical column. The water will be forced up in the opposite limb of the U tube by the weight of the vapor, which is heavier than air.



The U tube serves as a gauge

Why Turbine Blades Are Curved

PLACE a toy automobile, with a flat rectangle of tin attached as a sail, in the breeze of an electric fan. The car will travel forward until friction balances the wind pressure on the sail. Now repeat the experiment with a sail of equal area, but bent like a hand-written "n". Started from the same spot, the car will travel considerably farther. Back pressure, produced by air swirling back from the curved surfaces, now supplements the direct wind pressure. This shows why turbine blades are curved. Turbines of the Pelton-wheel type use the principle to conspicuous advantage.



The breeze from the fan drives the toy car forward

Chemistry of Fuels

FUN with fuels, in easy and entertaining chemical experiments, awaits every owner of a home laboratory. A miniature gas works will enable you to manufacture sizable quantities of coal gas, on the same plan that industry uses. You can test gasoline and kerosene for impurities, and, by a bit of chemical magic, transform liquid alcohol into a solid fuel.

In earlier experiments, you may have obtained inflammable gas from coal by distilling it in a clay pipe or test tube. Here is a larger-scale method that gives you a better chance to watch the interesting reactions involved, and that has the additional advantage of delivering a more highly purified product.

A pint-size tin can of the type fitted with a press-on lid, such as a paint can, will serve as a retort for this experiment. Punch a hole in its side, near the top, and attach a take-off outlet for the gas to be produced. This connection may be a valve stem (minus the insides) from an old inner tube, or an automobile fitting of the sort that diverts water from the radiator hose to a car heater. Either type can be purchased new for a few nickels. A thickness of asbestos paper, inside and out, will make a gas-tight joint when the fitting is screwed to the can, as seen below. To this outlet, attach glass tubing reaching to the bottom of a side-necked test tube or flask. Connect the side neck, in turn, with a gas purifier. This may be a piece of glass tubing four to six inches long, and half an inch to an inch in diameter, fitted with a short metal tube for an outlet. Filled with chemically impregnated wood shavings, this part of your apparatus will free the gas of impurities, just as is done in commercial gas-works practice. Prepare the wood shavings by soaking them, first, in a solution of ferric chloride or some other ferric (iron) chemical. Dry them. Barely moisten them with some ammonium hydroxide or household ammonia, and dry them once more. Finally, dampen them with a light sprinkling of water before packing them into the gas-purifying tube.

To operate your miniature gas works, place an ounce or two of coal in the retort. Tap the lid into place, and start heating the can with a Bunsen burner. Coal gas will soon stream from the retort. Passing in turn through the con-

By RAYMOND B. WAILES

MINIATURE GAS WORKS. You can make fuel gas from coal, wood, paper, corncobs, and other solid combustibles with the simple apparatus shown here. The outlet of the tin-can retort is a radiator-hose heater connection or an inner-tube valve fitting, as at right

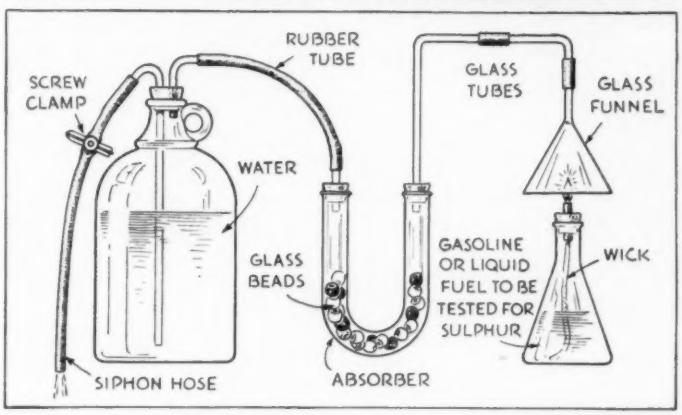
Seen in Easy Tests

denser and the purifier, it will issue from the metal-tube outlet, where you can ignite and burn it. .Meanwhile, water and eventually ammoniacal liquor will collect in the side-necked condenser. Much tarry matter is also condensed from the gas here. In the adjacent purifying tube, the chemically prepared shavings, which your treatment has impregnated with a precipitate of iron hydroxide, will remove hydrogen sulphide from the gas. You can see the shavings turn from brown to black as the iron compound interacts with the hydrogen sulphide vapor to form black iron sulphide.

When the output of coal gas dwindles to a feeble stream, which is not revived by heating the retort more strongly, you can "shut down the plant." Let the retort cool, and remove the lid. You will find the can now contains coke, which consists essentially of carbon and coal ash.

You can also use your retort to make gas from wood, paper, straw, corncobs, sawdust, and any other inflammable material of similar nature. If you use blocks of wood, the charcoal produced from them will be identical in shape with the original blocks, except perhaps for a bit of curling.

Just what happens in the retort, when you make gas by this process of "destructive distillation," is little known. The reactions must be exceedingly complex. As you saw, however, inflammable gas and coke or charcoal are produced. You can show that ammonia was also formed, by dipping a strip of red litmus paper into the liquid in the condenser. The paper will turn blue upon contact with the alkaline ammonia. The presence of hydro-



TESTING GASOLINE OR KEROSENE FOR SULPHUR. This is the "lamp test" used by Government scientists. Water siphoning from the jug draws fumes from the lamp through the U tube, where any sulphur dioxide present is absorbed by a solution of sodium carbonate

gen sulphide, visibly indicated by the color change in the impregnated shavings, may be confirmed in another way during the experiment. Direct the gas, before it passes into the purifier, upon a strip of paper moistened with a solution of lead acetate. The paper will turn black, due to the formation of lead sulphide.

Part of a chemist's bag of tricks is knowing just how to clean his tubes and flasks of the stickiest and stubbornest products of his experiments. You will find you can remove the tar from your condenser with a bit of benzine (benzol) as a solvent. A solution of chromic acid will also do the work. This liquid makes a good all-around cleanser for laboratory glassware, and can be used over and over a number of times before it loses its strength. To make it up, add about five grams (one teaspoonful) of powdered potassium dichromate to a mixture of about twenty-five cubic centimeters (a scant fluid ounce) of strong sulphuric acid and five cubic centimeters (a teaspoonful and a half) of water. Handle the powerful acid that results with due respect. To show its strong oxidizing action upon carbon-containing substances, especially when it is hot, warm some of the liquid with powdered coal in a beaker. The coal effervesces, chemically combining with the oxygen in the chromic acid—a sort of "burning" without a flame.

Converting a liquid fuel into a solid one makes a striking chemical stunt. To do this, heat about 300 cubic centimeters (ten fluid ounces) of denatured alchohol in a tin can. An electric soldering iron immersed directly in the alcohol will heat it safely, or you can place the can in very hot water. Melt six or seven grams (about two teaspoonfuls) of stearic acid in a tin-can lid, and pour it into the heated alcohol. It will dissolve instantly. Now dissolve about a gram, or small lump, of sodium hydroxide (lye) in four or five cubic centimeters (about a teaspoonful and a half) of water, and add the solution to the contents of the can. Sodium stearate, or ordinary soap, is formed. When the liquid cools, the white soap solidifies, with the alcohol distributed through it. Apply a match to a portion of the product, and you will find that it will burn around the edges.

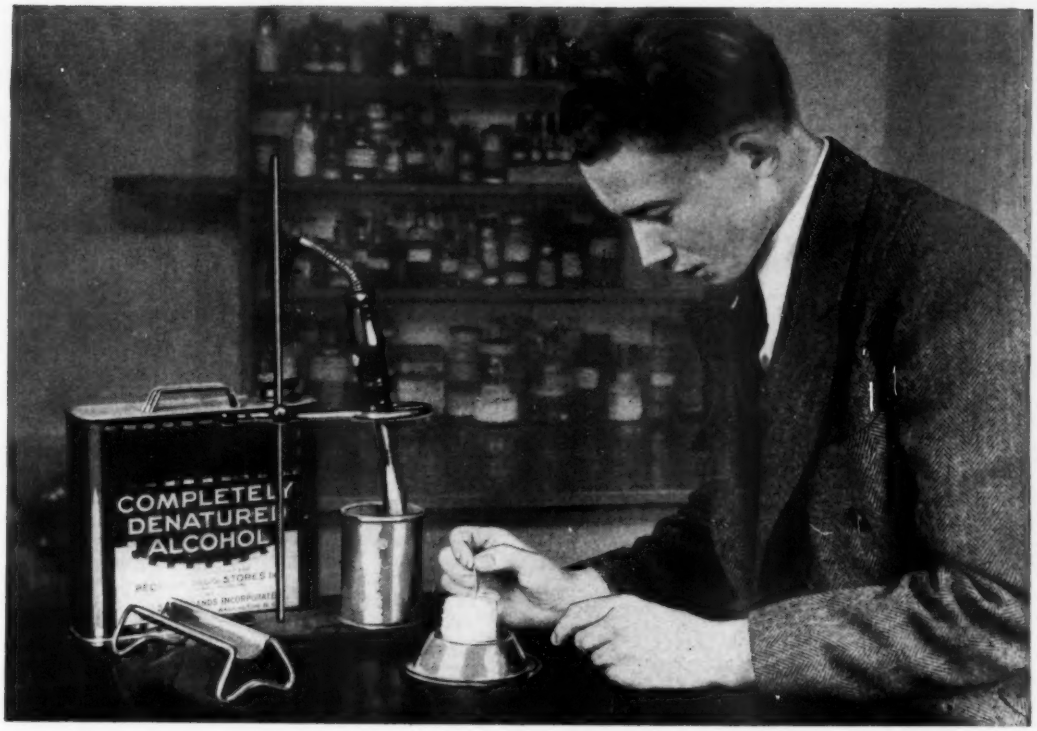
You can also make "solid alcohol" by adding a concentrated solution of calcium acetate to about nine times its volume of denatured alcohol.

Gasoline that contains tetraethyl lead makes a fine motor fuel, but should not be used for cleaning or other household purposes because of its toxic properties. You can easily test a sample of gasoline to determine whether this organic lead compound is present. Place about five cubic centimeters of the gasoline in a test tube, and add several cubic centimeters of a solution of sodium hypochlorite. The kind sold under various names for laundry use will work satisfactorily. Shake the test tube. Add several drops of a dilute solution of potassium chromate, and shake again. Finally, make the solution acid with several drops of strong acetic acid. All of the chemical solutions will form a watery layer underlying the gasoline in the test tube. If a yellow precipitate forms in this lower layer, after you have added the acetic acid, then the gasoline contains tetraethyl lead.

GASOLINE and kerosene should both have as low a sulphur content as possible. Sulphur is objectionable in motor gasoline because as little as a tenth of one percent will cause pitting of the engine valves. Also, sulphurous compounds formed when sulphur burns are toxic. You can test gasoline and kerosene for sulphur by a simple "lamp method," much as they are actually tested in many Government and commercial laboratories.

Tetraethyl lead in gasoline makes it unsafe for use in the home. Its presence is easily detected by making a simple test

Place the gasoline (or kerosene, for which just the same procedure may be used) in a small flask or bottle, which should have a wide base so that it will not tip over and spill the inflammable liquid. Fit the vessel with a one-hole stopper, slotted on one side. The central hole in the stopper should carry a glass tube containing a wick of soft string. Above this improvised lamp, mount an inverted funnel, and connect the funnel with glass tubing to a U tube containing glass beads. To the opposite limb of the U tube attach L-shaped tubing that ends within the top of a jug of one-gallon or greater capacity. Fill the jug with water, and arrange a siphon tube to drain the water out, under



Converting alcohol into a solid fuel makes a striking chemical stunt. The alcohol is heated with an electric soldering iron, for safety, and mixed into a homemade soap. When this solidifies, pieces of it will burn

the control of a pinch clamp. This draws the vapors from the lamp through the apparatus. The two-hole stopper of the jug, and all the rest of the connections, must be air-tight.

Now place about ten cubic centimeters of sodium carbonate solution in the U tube. A ten-percent solution will be of suitable strength. Light the lamp. Its wick should be adjusted flush with the glass tube in the stopper, to give a flame about three sixteenths of an inch high. Start sucking air through the train of apparatus by opening the pinch clamp, allowing water to drain from the large jug, and place the lighted lamp under the funnel. Let it burn for as long as an hour, if possible. Meanwhile the water jug should be replaced with a full one, or refilled, as it empties. During this time, the sulphur in the gasoline will burn to form sulphur dioxide, which will be absorbed by the sodium carbonate solution in the U tube.

When the lamp has burned for an hour, or its fuel is exhausted, wash the solution from the U tube with water. Add to it several drops of ordinary drug-store hydrogen peroxide; warm; and add hydrochloric acid, drop by drop, until the solution just shows acid with litmus paper. Finally add several cubic centimeters of barium chloride solution, of about ten-percent strength, and boil the entire mixture. This will precipitate any sulphur contained in the gasoline, in the form of a white precipitate of barium sulphate.

If your reagents themselves contain any sulphur as an impurity—as they will unless highly purified—this sulphur will also be precipitated. Therefore, in case you are uncertain of the purity of the sodium carbonate and other chemicals, give them a "blank test" before you blame all the sulphur on the gasoline. Perform the experiment in duplicate, upon an equal quantity of sodium carbonate solution that has not been exposed to the vapors of the lamp, and the relative amount of precipitate will show where most of the sulphur comes from.

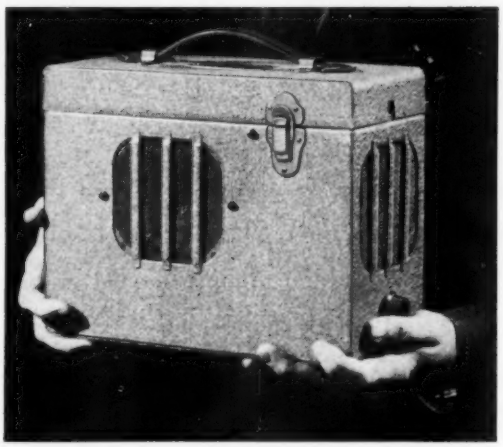
In all fairness, you should also be wary of jumping to conclusions from any attempt to apply the lamp test in comparing different brands of gasoline. It is true that the brand producing the most precipitate contains the most sulphur, if the tests are carried out under identical conditions—and that is a highly important "if." Exactly the same quantity of sodium carbonate must be used for each trial, and must be measured out from a pipette, not a graduated cylinder, for sufficient accuracy. Likewise, the quantities of hydrogen peroxide and of other reagents must be alike. *(Continued on page 238)*

Six New Ideas

Crystal Unit for Pick-Ups Is Easy To Install

DESIGNED to fit into the head of almost any radio-phonograph pick-up arm, a compact high-fidelity crystal unit, complete with needle holder and thumbscrew, has just been made available to amateur radio fans for replacement or experimental purposes. Contained in a molded-composition shell, the device, shown in the illustration below, is provided with two small lugs set conveniently in one side where they facilitate the work of making connections to the amplifier circuit of either a radio or an electric phonograph.

The handy crystal pick-up fits most phonograph arms



Public-Address System Housed in Midget Case

SMALL and light in weight, the complete, portable public-address system illustrated above nevertheless contains two speakers and a powerful amplifying circuit. A hand microphone, attached to twenty-five feet of cord, and a long power cord are supplied with the unit, which can be set up quickly.

Radio-Newspaper Receiver for Home Use

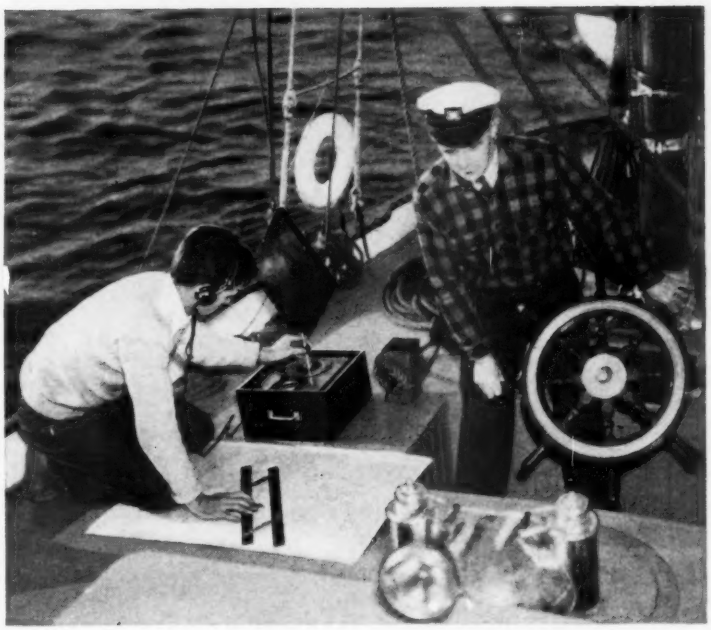
DESIGNED to fit the top of a commercial table receiver which it matches in cabinet style, a complete radio-newspaper receiver for home use has just been placed on the market. All necessary apparatus for receiving and printing news bulletins and pictures transmitted over the air are contained in the unit. The news is automatically printed on a continuous sheet of paper that unwinds from a roll as it is received. The instrument can be used in conjunction with any radio receiver, the manufacturer declares, provided it has an output of at least five watts.

Anyone can now own one of these home-model, radio-newspaper receivers

for the Radio Fan

Batteries Power Radio Compass for Small Boats

BUILT of corrosion-resisting materials for use on salt or fresh water, a compact new radio compass especially designed for use on small boats as a navigation aid is battery-operated and entirely self-contained. A beacon selector, combination switch and volume control, and a compass repeater, constitute the three simple controls which enable an amateur skipper to "fix his position" or "follow home" with a minimum of trouble. The loop antenna, housed in the removable lid, is easily mounted on a shaft extending from the portable set.



The loop antenna for the compass is housed in the removable cabinet lid

Remote Control for Record Players

RECORD players can now be used with any receiver without making actual connections into the receiver circuit. The secret lies in an inexpensive adapter unit now available consisting of a compact two-tube transmitter that actually transmits the "music" to the receiver. In use, the attachment is simply plugged into a convenient house-wiring outlet and connected to the phonograph pick-up. Tuned to the adapter, the receiver picks up and reproduces the phonograph's music.

Acting as a transmitter, the adapter eliminates all receiver connections

Radio Tuner Has No Condensers

BASED on an entirely new principle, a compact new radio tuning unit for use in home-built receivers dispenses with the use of variable condensers. Tuning is accomplished by iron cores which can be moved up and down inside two ganged coils, thereby changing their inductance.

MARIE ANTOINETTE DOLL CONCEALS

Dressing-Table Radio

By FRANK TOBIN

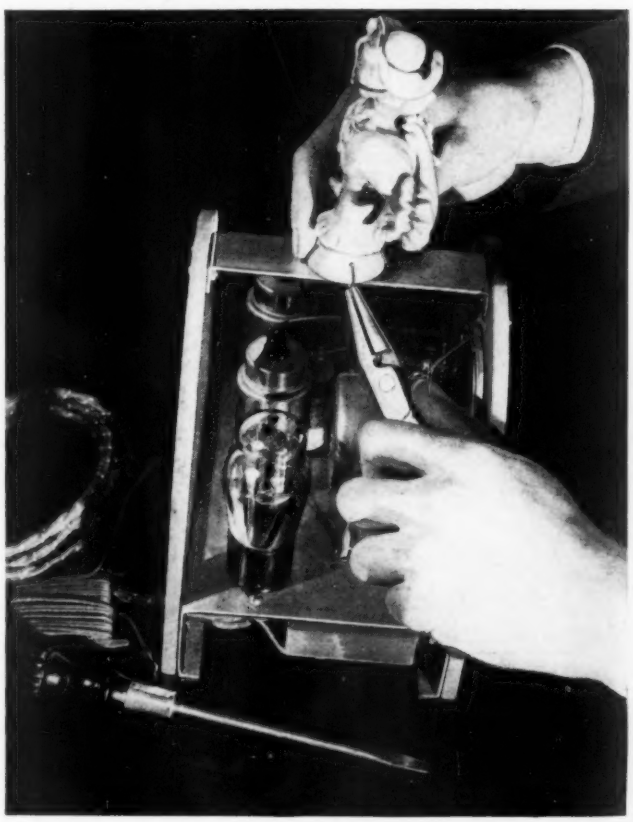
WHEN a friend asked me to design an all-electric dressing-table receiver that would provide good broadcast reception, yet would not look like a radio, I hit on the idea of housing the circuit in one of the old-fashioned dolls popular some years back for concealing bedroom telephones. The result is the Marie Antoinette radio shown in the photographs. It provides good loudspeaker volume on all major stations, yet it matches the frilly femininity of the average dressing table.

Compactness being an important factor, the A.C.-D.C. circuit was designed around two brand-new dual-purpose tubes, making it possible to obtain five-tube power and sensitivity with little more than half the number. The two new tubes are designated as the 6C8G and the 25A7G. The 6C8G, which consists of two triodes, is used in the set as the combined detector and first audio-amplifier stage. The detector, using the bias method of detection, is resistance-coupled to the first audio stage. Bias for the detector tube is obtained by means of a 100,000-ohm, ½-watt resistor bypassed by a 5-mfd. electrolytic condenser.

The second new tube used, the 25A7G, serves as a combined high-power pentode output tube and a half-wave rectifier. The 25A7G, although similar to the older 12A7, has a much higher output rating. Consequently, extreme care must be exercised to obtain adequate filtering to eliminate any possibility of trouble due to excessive hum. In the circuit shown, additional filtering was incorporated in the design in the form of a 1,000-ohm fixed resistor and a 24-mfd. electrolytic condenser. These parts are indicated in the wiring diagram of the circuit. Resistance coupling was used to couple the first and second audio stages, and a 5-inch permanent-magnet dynamic speaker was chosen to handle the output.

All parts, with the exception of the speaker, can be mounted directly on the 2 by 5½ by 8-in. aluminum chassis. For convenience in wiring, the antenna coil can be mounted directly on the ganged tuning condenser, while the radio-frequency coil, the filter choke, and the electrolytic condensers can be mounted under the chassis. The grid lead to the 6C8G should be shielded to insure stability of operation and to avoid any possibility of troublesome coupling with other parts of the set. Both the 6K7G (radio-frequency tube) and the 6C8G can be shielded by means of the conventional ventilated aluminum cans.

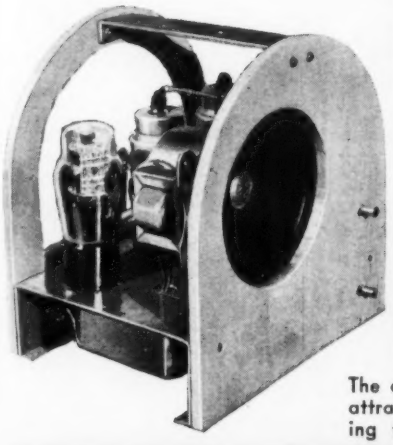
When connecting up the rectifier and power



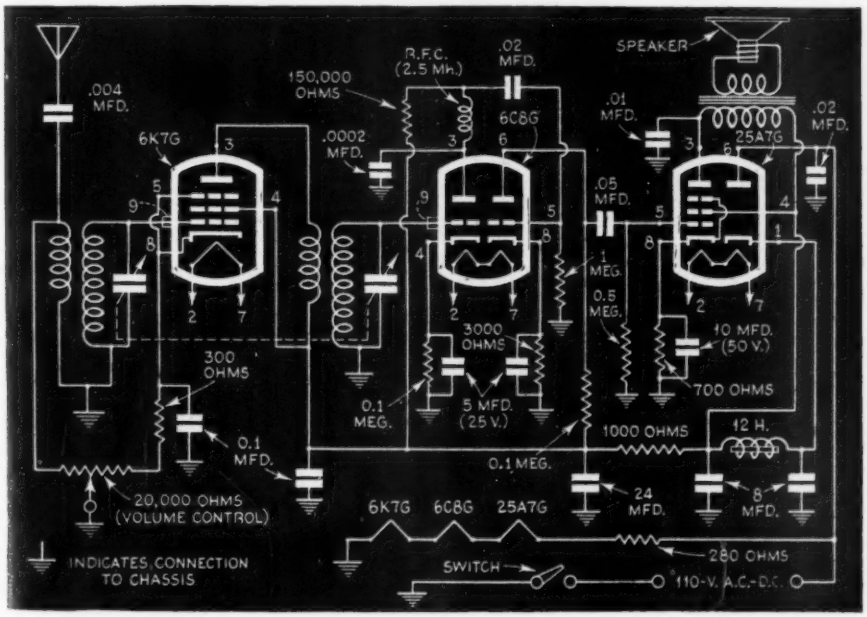
Wire and glue can be used to mount the porcelain figurine on the aluminum brace at the top of the cabinet. Suitable dolls, once popular as telephone covers, can be obtained for a dollar or less

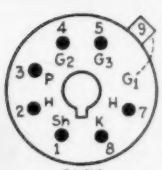
circuit, care should be taken in wiring the power cord and its built-in filament resistor. The resistance wire, generally distinguishable by its asbestos covering, *must* be connected to the filaments.

To form the cabinet and provide a mounting for the doll figure, two rounded wooden panels, 8½ in. high, 8 in. wide at the base, and 5/16 in. thick are attached to the chassis. The panels should be reënforced at the top with an aluminum strip 5½ in. long and 1½ in. wide. This also serves as the support for the doll. Strong glue and wire can be used to hold the porcelain body of the



The completed Marie Antoinette doll forms an attractive and useful decoration for a dressing table. The cabinet is shown at the left

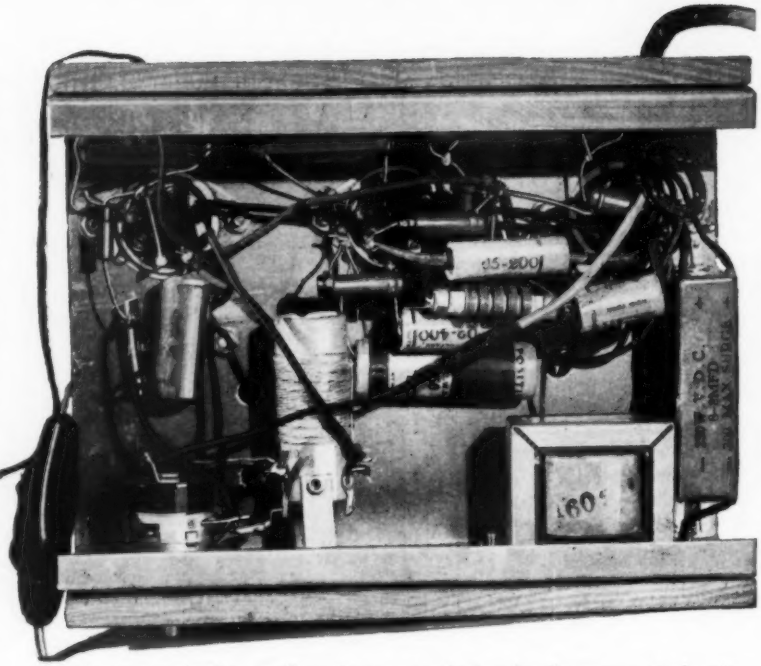




When wiring the tubes follow these socket diagrams carefully

doll securely in place. In the original, the doll's dress with its full skirt was made of taffeta and bordered around the bottom with a lace frill 2 in. wide. Any materials available, however, can be used. This completely hides the receiver. The doll was purchased at a small antique shop for a dollar. With a little shopping, however, less-expensive figures can be obtained.

To provide adequate ventilation for the tubes, a large hole should be cut in the rear panel of the cabinet. A sheet of cardboard; or better still, asbestos board; should be placed at the top of the cabinet to protect the skirt material from the heat of the tubes. The two tuning controls, one for the ganged tuning condenser and the other for the combination volume control and switch, can either be hidden under the doll's skirt or mounted on the outside.



Condensers and other small parts are mounted under the compact chassis

In use, the receiver requires only an antenna, twenty or thirty feet long, strung around the baseboard or ceiling molding. No ground should be used, as the A.C.-D.C. hook-up is grounded through the house wiring and additional grounding would blow the tubes.

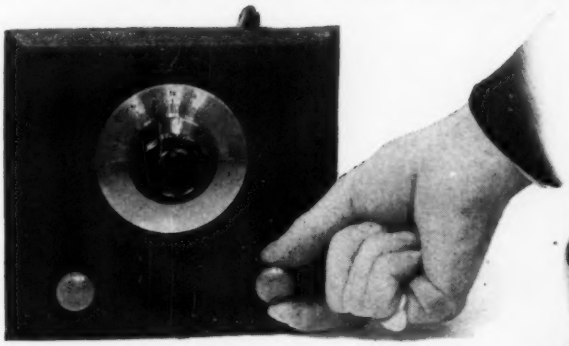
No outside ground connection is needed with the receiver. Only the short flexible antenna wire, at the left, is necessary to get excellent reception

LIST OF PARTS

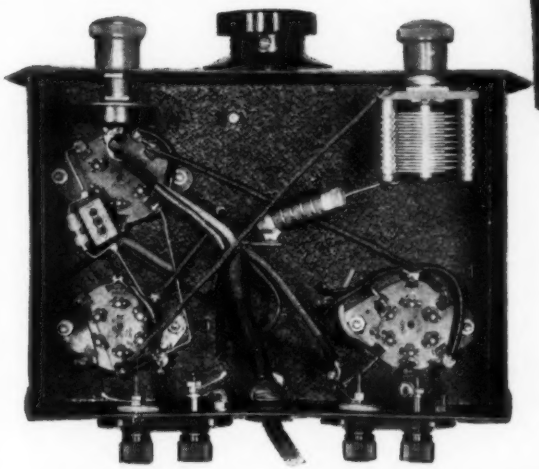
Two-gang tuning condenser, .00036 mfd.
Fixed condensers, two, .1 mfd.
Fixed condensers, two, .02 mfd.
Fixed condenser, .05 mfd.
Fixed condenser, .01 mfd.
Fixed condenser, mica, .004 mfd.
Fixed condenser, mica, .0002 mfd.
Electrolytic condenser, dual, 8-8 mfd., 250 volts.
Electrolytic condenser, dual, 5-5 mfd., 25 volts.
Electrolytic condenser, 10 mfd., 50 volts.
Electrolytic condenser, 24 mfd., 150 volts.
Fixed resistor, 100,000 ohms, ½ watt.
Fixed resistor, 150,000 ohms, ½ watt.
Fixed resistor, ½ meg., ½ watt.
Fixed resistor, 1 meg., ½ watt.
Fixed resistor, 300 ohms, ½ watt.
Fixed resistor, 700 ohms, 1 watt.
Fixed resistor, 3,000 ohms, 1 watt.
Fixed resistor, 1,000 ohms, 1 watt.
Plate choke, 2.5 mh.
Filter choke, 12 h.
Midget volume control with switch, 20,000 ohms.
Miscellaneous.—Power cord with 280-ohm resistor, matched antenna coil and radio-frequency coil, speaker, chassis, tubes, sockets, shields, doll, dress materials, wire, solder, etc.

Two-Tube Receiver

BRINGS IN FOREIGN STATIONS



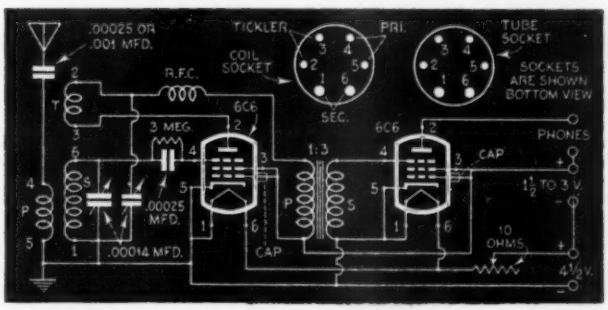
Three controls operate the long-range receiver



Mount tubes, tuning condenser, transformer, and plug-in coil atop the chassis; other parts (left) below it

ALTHOUGH it operates without high-voltage "B" batteries, the two-tube, all-wave receiver illustrated will bring in London, Rome, and Berlin as easily as local broadcasts. Using two 6C6 tubes, the circuit is basically an improvement over the original "B"-batteryless set already described (P.S.M., July '36, p. 52). The secret of the hook-up lies in a reversal of the grids in the tubes. In this receiver, the suppresser grid (4) in each tube becomes the control grid, while the two grids nearest the cathode (3 and cap) are connected to the positive side of the three-volt "B" supply. This arrangement causes an unusually large number of electrons to flow from the cathode toward the plate, and results in increased power at low voltages.

For short-wave reception, a "B" supply of 3 volts is used, but for the broadcast band this may be reduced to 1½ volts. With a short aerial, no antenna trimmer condenser is used. For longer aerials, use either a .001-mfd. or a .00025-mfd. condenser. The filament rheostat must deliver from 3.4 to 3.8 volts to the tube heaters.—ARTHUR C. MILLER.



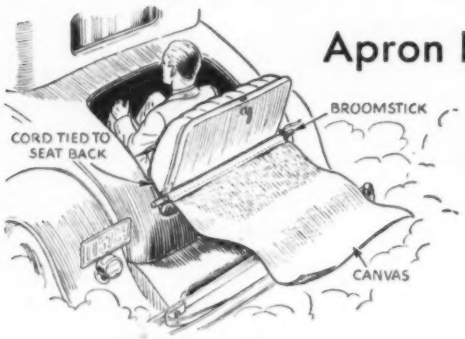
Specifications for the parts are given in this wiring diagram

Helps for Car Owners

Handy Hook Holds Lugs for Changing Wheels

TO PREVENT losing lugs while changing car wheels, motorists can use the easily made holder shown at the right. A U-shape wire hook is fastened to a rubber vacuum cup, and the latter stuck onto a near-by fender when changing a wheel. As lugs are removed, drop them over the wire hook. instead of tossing them on the ground where they may be lost. When you are ready to put them back on again, the lugs are all stacked in a convenient and easily reached position. The device can be carried in the tool kit.—E.C.

Apron Keeps Dust off Rumble Riders



PROTECTING rumble-seat passengers from the dust that swirls up with the air currents back of a moving car, can be easily accomplished by attaching a piece of canvas to a broomstick and fastening the latter against the seat back with cord or rope. The free, flapping canvas breaks up the swirling currents to prevent dust from showering over the rumble-seat occupants. The device can be detached when not in use.—A.H.W.

Sun Visor Air-Cools Driver

HERE is a simple trick that will help you to keep cool while driving in hot weather. If you have a windshield that opens out, push it forward a few inches to allow cool air to stream in and upward toward the top of the car. Then adjust your sun visor to direct the cool air down onto your face, as illustrated in the drawing.—E.H.

Foot Rest for Long-Distance Trips

A HANDY foot rest for car owners making long trips can be made from an old connecting-rod shaft. The crankshaft end of the rod is clamped to the steering post, as shown in the illustration at the left, in any position and at any height that is most convenient for the driver. The piston-end clamp on the rod will keep the motorist's foot from sliding off the rest. In long-distance driving the rest permits a change of foot position to relieve fatigue.—A.B.

4 Big Qualities in One Gasoline

THEY LOOK ALIKE—but don't be fooled! You can buy gasoline with one or two good qualities, or you can get the Big 4: *Pick-up... Power... Mileage... Cleanliness!*

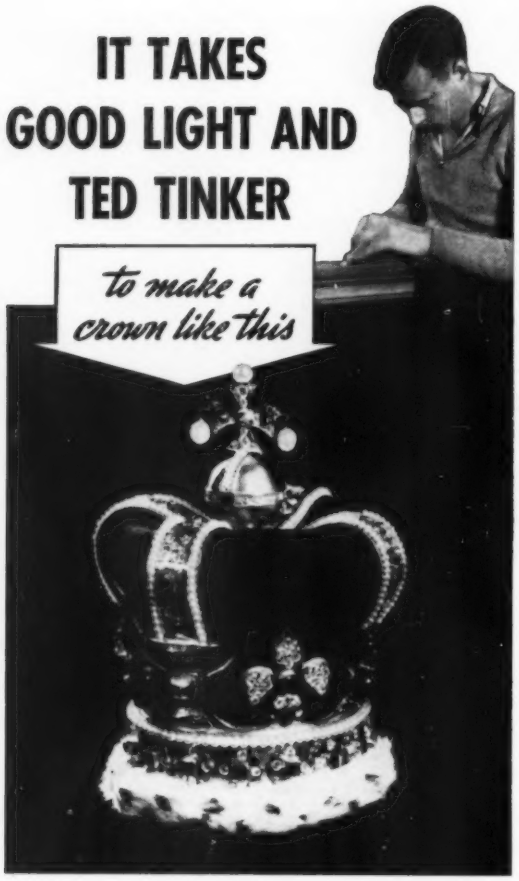
You get all 4 in Mobilgas. This gasoline is made for modern, high-speed engines. It atomizes fast...fires quickly and completely. It's cleaned not once...but *6 times!* And every drop is selected for high octane value. Try Mobilgas today! Socony-Vacuum Oil Company, Inc.

Mobilgas
SOCONY-VACUUM

MOBILGAS *For Balanced Performance*

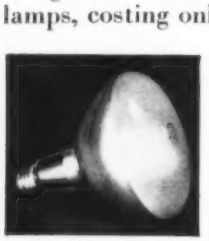
IT TAKES GOOD LIGHT AND TED TINKER

to make a crown like this



● "I have never done a job where good lighting was so imperative," says Ted Tinker, famous advertising designer, "as on this 4-inch-high Coronation Crown. It was done in sterling silver, gold plated, with several hundred *real* gems!"

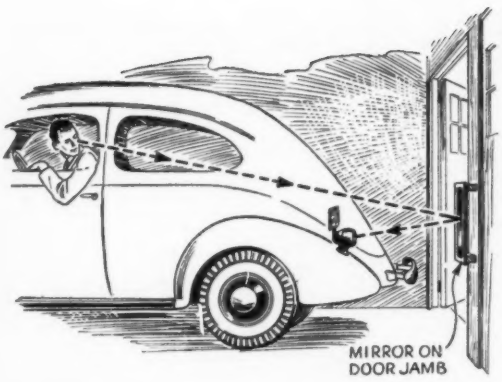
The Tinker workshop, where this Crown and many other display masterpieces were made, is lighted with five 150-watt G-E MAZDA lamps, costing only 20c apiece.



NEW G-E MAZDA Reflector Lamp . . . a 150-watt bulb and reflector in one sealed unit! Perfect for downlight on difficult workshop jobs. Sells for only $1.10.

GENERAL ELECTRIC MAZDA LAMPS

They stay brighter longer



Mirror Near Garage Door Checks on Tail Lights

A QUICK and easy way to make sure that the tail and stop lights on your car are working properly before you leave your garage, is shown in the illustration above. Fasten a small mirror on the garage wall near the door, or on the door jamb, in a position so that it will reflect the rear fender lights into your eyes as you look around to back out. Some day, this may save you a bout with the law over an unlit tail light.—K.W.W.

Refrigerator Dish Covers Fix Headlamps for Fog

FOG LAMPS are handy accessories to have on your car for lighting your way through spring mists. I couldn't afford them, but I found that an efficient substitute can be made from oiled-silk dish covers of the type sold for use in refrigerators. These come in a yellow color, with an elastic around the rim, making it a simple matter to slip one over each headlamp lens. They can be conveniently carried in a pocket of the car and slipped on at a moment's notice whenever you run into fog. I have found that they work well.—J.M.

FISHER FACTS

WIDER VISION for greater safety! The total window and windshield area of De Luxe Six and De Luxe Eight Pontiac four-door sedans (illustrated) is 412 square inches larger than last year, includes a 30% larger windshield. Also, the rear view mirror is more efficiently placed and the rear window post eliminated.

The Inside Story of SAFETY

in the 1939 BODY *by* FISHER

BUILD a steel body as solid and weave-proof as possible — you still can't assure its passengers complete protection, until you've made it *safe inside,* too!

That's why Fisher engineers took such great care with the interiors they built for the new General Motors cars — why they gave the new Body by Fisher a *new visibility* as well.

You can see in the illustration above what a broader outlook you get — for bringing overhead traffic lights into easy view, for providing a better picture of the traffic situation on both sides and behind, for giving passengers wider vision, as well.

And to add to this inside story of safety, all Ventipanes are fitted with locks to protect the car and its passengers from intrusion.

Likewise in comfort, the 1939 Body by Fisher leaves nothing undone. Its interiors have more ride-easy roominess—front and back. What's more, improved Fisher No Draft Ventilation now makes it easier than ever to control the circulation of fresh air to suit yourself.

While as for style, just take a look at any of the new General Motors cars—the only cars with Unisteel Turret Top Body by Fisher.

BODY BY FISHER

ON GENERAL MOTORS CARS ONLY:
CHEVROLET • PONTIAC • OLDSMOBILE • BUICK
LA SALLE • CADILLAC

Watch for

NATIONAL HARDWARE WEEK

MAY 6 TO 13

Your hardware store always carries a tremendous variety of worthwhile merchandise . . . sound values that will save you real money. But during National Hardware Week, May 6 to 13, your dealer will display an especially attractive assortment of fine merchandise.

A world's fair in your own backyard! Don't miss it! And in particular, don't miss the attractive displays of the famous Carborundum Brand Abrasive Products which for years have helped make work easier for the home craftsman. You'll certainly want one of these sharpening stones, or grinding wheels to keep edged tools in tip-top shape. Patronize your hardware dealer.

CARBORUNDUM ABRASIVE PRODUCTS

Write Dept. PS 5-9

THE CARBORUNDUM COMPANY

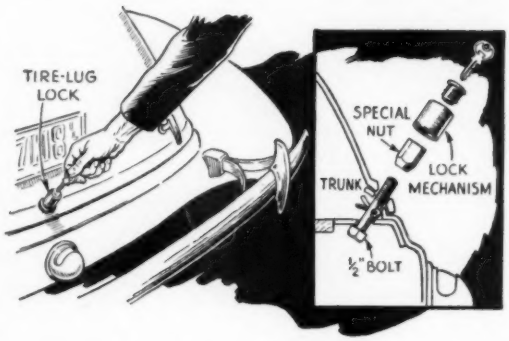
REG. U. S. PAT. OFF.

Niagara Falls, N. Y.

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

(Carborundum is a registered trade-mark of The Carborundum Company)

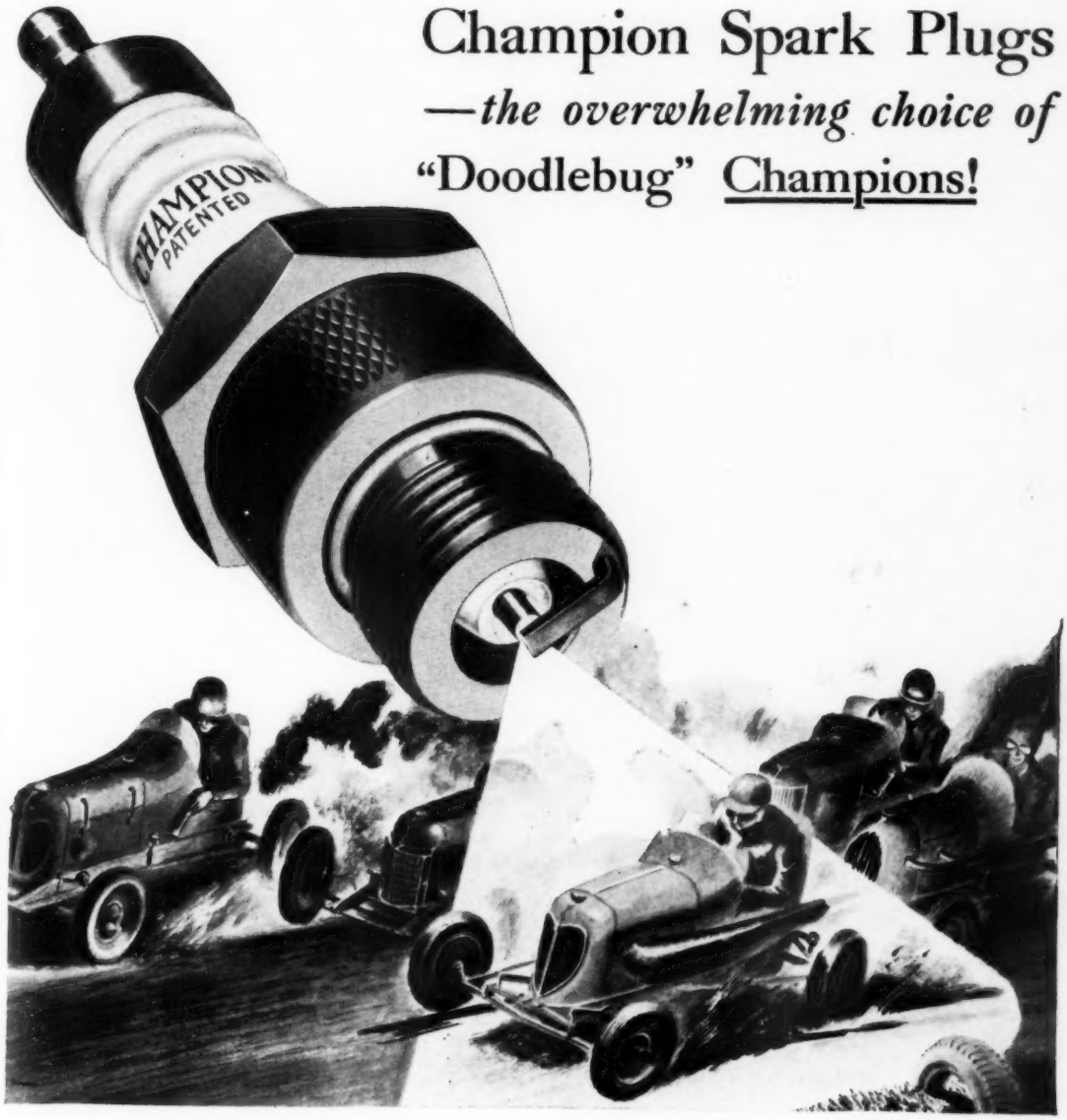
Pickproof Auxiliary Lock Guards Trunk Compartment



THIEVES would have a difficult time getting into an automobile trunk compartment that is protected not only by the regular lock but also by the pickproof auxiliary lock shown in detail in the inset above. This assembly makes use of a spare-tire, lug-type lock, and a special nut made to fit a standard tire lug bolt and hollowed out to take the lock mechanism. The head of the bolt is anchored within the compartment by drilling a hole in the trunk bottom and inserting the bolt from below, as indicated. A cotter pin slipped through a small hole drilled through the bolt will prevent the latter from dropping out. The bolt extends up through a hole made in the trunk lid, and the nut is screwed tightly onto it. A case-hardened cylinder is then slipped over the nut, the lock mechanism inserted, and the key removed. The cylinder, being free to revolve, effectively prevents the nut from being unscrewed once the lock is in place. This type of pickproof lock should prove of special value to salesmen, tourists, and others who often have occasion to leave articles of value in the trunk compartments of their cars while parked.—M.J.

An Easy Way To Start Up a Water-Logged Engine

AUTOMOBILES left standing out in a drenching downpour sometimes become "water-logged" and are difficult to start. Most motorists try to remedy the difficulty by wiping off the spark plugs and wiring, or brushing pools of water from the plug receptacles. I've found that the starting difficulty is generally due to water getting into the distributor. Simply remove the distributor cap, wipe out the moisture between the contacts, and replace the cap. Nine times out of ten, the motor will start up immediately, even though the cylinder head is sopping wet.—J.S.



Champion Spark Plugs
—*the overwhelming choice of* "Doodlebug" Champions!

Buncned like hounds on a scent, wheel to wheel and fighting every inch of the way, a pack of midget race cars or "doodlebugs" roars and slides 'round a small race track. In this, one of the fastest-growing sports in the nation, midget race car drivers must have split second response to accelerator. They know their spark plugs must withstand fouling, and pre-ignition due largely to leakage—common to ordinary spark plugs—and eliminated by Champion's patented Sillment seal. Records show practically every "doodlebug" champion, national and sectional, as well as the majority of all racing drivers, insists on dependable Champion Spark Plugs. Use the spark plugs champions use and you will insure all 'round better engine performance in your car.

IT'S THRIFTY TO INSTALL NEW SPARK PLUGS — *Demand CHAMPIONS*

Most Important Thing About SAWS Is . . .
Keep 'em Sharp! These Two Files By NICHOLSON Are Ideal . . . .
For Most Saws Used On Your Farm, In Your Yard or Home Workshop . . .

Ask your hardware store what brand skilled saw filers buy and Nicholson Files will steal the show! *No wonder* —for the world's file leader knows how to make saw files that are uniformly keen and long-lasting Nicholson Mill and Slim Taper Files, shown, are awaiting you at your hardware store, factory-new in cellophane wrapping. Nicholson File Company, Providence, R. I., U. S. A. Canadian Plant, Port Hope, Ontario.

A FILE FOR EVERY PURPOSE

NICHOLSON FILES
PIONEERS IN QUALITY PRODUCTION
75th ANNIVERSARY YEAR

New Lapstreak Skiff
ADDED TO OUR
BOAT PLANS

DESIGNED with a skiff type of hull and lapstreak construction, our new outboard boat is immensely strong and durable, and may be used on any water—river, lake, or ocean. It requires no soaking, being always ready for use. Complete plans and building instructions cost only 50 cents.

Seven persons may be carried in this skiff

The skiff is 13′ 9″ long, has a 4′ 7″ beam, weighs 225 lb., carries as many as seven persons, and costs approximately $35 to build. Any outboard from 1 to 16 h.p. may be used, and the speed varies from 5 to 45 m.p.h., depending upon the motor.

Plans for other boats as well as radios, furniture, models, and novelties are also available. A few of them are given below; a complete blueprint list will be sent upon receipt of a self-addressed and stamped envelope. If you are interested only in boats, ask for our special boat list.

BOATS

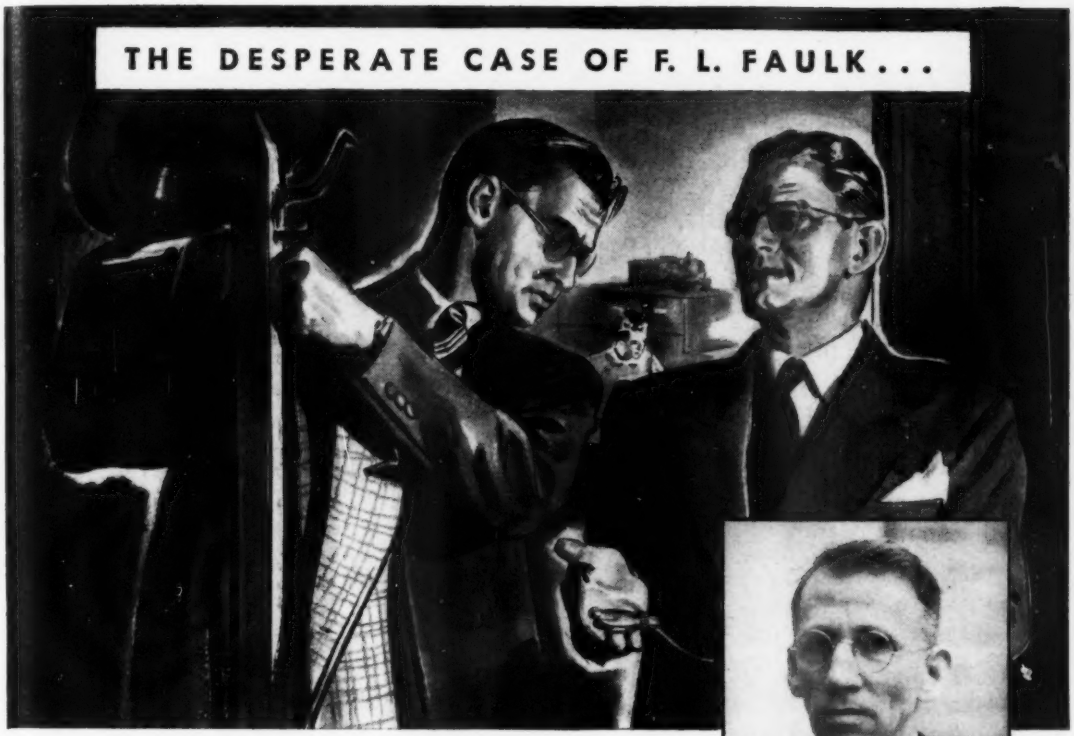
Cabin Cruiser, 17′ long, weighs 750 lb., for use with outboard or inboard drive, 356-357-358-359 ..... $1.00
Folding Duck Boat, 13′ long, 170-R ..... .50
High-Speed Boat for Small Outboard Motors, 7′11″ long, 257-R ..... .50
Midget Boat or Pram, 9′ long, for oars, sail, or outboard motor, 339-R ..... .50
Motorboat-Rowboat, 13′ long, with decked hull, for use with outboard or inboard drives and oars, 147-R ..... .50
Racing Sailboat BLACKCAT, 13′4″ long, weighs 250 lb., Marconi rigged, 321-322-323-R 1.00
Sectional Rowboat, 9′ 8″ long; can be used with small outboard, 340-341-R ..... .75
Skiff, 13′ 9″ long, 4′ 7″ beam, weight 225 lb., for 1 to 16 h.p. outboard motors; can be rowed, 363-R .50
Sport Runabout, 9′8″ long, for small outboard motors, weighs 100 lb., 309-310-R ..... .75
Utility Rowboat, 13′ long; can also be sailed or driven by outboard motor, 224-R ..... .50

MODELS

Brig MALEK ADHEL, 20″ hull, frame-and-plank or solid-hull construction, 304-305-306-R 1.25
Clipper Ship in a Bottle, 121-122 ..... .50
Clipper Ship SOVEREIGN OF THE SEAS, 20½″ hull, 51-52-53-R 1.00
Cody Coach, 13″ long, 144-145-146-R 1.00
CONSTITUTION ("Old Ironsides"), 21″ hull, 57-58-59-R 1.00
Cruiser U.S.S. INDIANAPOLIS, 12″ long, 216 ..... .25
Farragut's Flagship HARTFORD, 33½″ hull, 221-222-R 1.50
MAYFLOWER, 24″ long, 83-84-85-R 1.00

(Continued on page 218)

THE DESPERATE CASE OF F. L. FAULK...



F. L. FAULK
Monroe, La.

"Morning after morning, I was late..."

"... it got so I was absolutely dependent on my neighbors to give my car a 'push' to get started. There was no other way for me to get to work, so, morning after morning I was late.

"When the Boss spoke to me, I explained that I was doing everything I could ... that I had been to the garage several times...that I had even bought a new battery but still had trouble starting.

"He told me his Willard Dealer had an instrument that could locate the trouble, so, after work that day I went over. With his *Electrical Check Instrument* he discovered that undersize cables were causing the starting motor to draw so much 'juice' it starved the ignition system.

"Your Dealer rectified the trouble, including all the necessary parts, for less than $2.75. *THAT* made a ***Willard Starting Service*** believer out of me."

F. L. Faulk

How *YOU* Can Avoid Trouble

A majority of starting failures are caused NOT BY THE BATTERY but by little things like worn or undersize cables, loose connections, worn or faulty wiring, that drain the life out of a perfectly good battery without warning.

This new ***Willard Starting Service*** protects you against these hidden flaws—saves you money—saves you trouble. Let your Willard Dealer "x-ray" the starting system of *your* car—under actual load conditions—with his *Electrical Check Instrument.*

We offer you this ***Willard Starting Service,*** *as our way of EARNING your patronage. Come in and try it.*

Your Willard Dealer

You can identify our station by this sign.

If you are interested in the "why" and "how" of the instrument that makes this service possible, send a letter or postcard to Willard Storage Battery Company, Department C-5, Cleveland, Ohio.

KEEPS PRECISION MODELS

HUMMING!

MOBIL HANDY OIL

For home craftsmen! Light, penetrating, non-gumming. Excellent for working models. Prevents rust. Fine for sewing machines, vacuum cleaners, generators and other appliances. Free wall bracket with each can.

CAR ENGINES RUN QUIETER

MOBIL UPPERLUBE

Add it to your gasoline. Reaches the engine as a vapor. Special impregnating ingredient protects upper cylinder walls, piston rings, valve stems, from rust and wear. Reduces carbon.

Buy where you buy Mobiloil or Mobilgas

Mobil Specialties

MOBILGLOSS · MOBILWAX · MOBILWAX PAD
MOBIL HANDY OIL · MOBIL RADIATOR FLUSH
MOBIL WINDOW SPRAY · MOBIL UPPERLUBE
MOBIL HYDROTONE · MOBIL SPOT REMOVER

SOCONY-VACUUM

BY THE MAKERS OF MOBILOIL

Plans for Your Workshop

(Continued from page 216)

New Bedford Whaleboat, with complete equipment, 14" long, 326-R ..... .50
Old Naval Gun, a six-pounder in battery; gun is 7⅜" long; 9" by 11½" overall, 352 ..... .25
Privateer SWALLOW, a Baltimore Clipper, 13" hull, 228-229-230-R 1.00
Racing Yacht, 20" Marconi-rigged sailing model, 48-R ..... .50
Spanish Treasure Galleon, 24" long, 46-47 ..... .50
Trading Schooner, 17½" hull, 252-253 ..... .50
U. S. Battleship TEXAS, 3' hull, 197-198-199-200 ..... 1.00
Viking Ship, 20½" long, 61-62-R ..... .75

[Construction kits are available for some of these models. Turn to page 220]

FURNITURE

Colonial Writing Desk, Governor Winthrop style, 3'6" high and 3'8" long, 21 ..... .25
Combination Bench and Tilt-Top Table, (no turning), 11 ..... .25
End Table, American Empire, 241A ..... .25
Gate-Leg Table, 3'6" diameter, circular top with leaves up (no turning), 24 ..... .25
Kitchen Table Cabinet, 27" by 48" top, has folding seat (no turning), 27 ..... .25
Low Stand, Early American Style; also Cactus Plant Holder and Metal Candle Stand, 361A ..... .25
Modernistic Stand (24⅜" high) and Bookcase (70½" high), 88 ..... .25
Sewing Cabinet of 1812, 178A ..... .50
Small Early Colonial Pine Chest, 32" long, 21" deep, 24" high, 308A ..... .25
Tavern Table and Scroll Mirror, 105 ..... .25
Telephone Table and Stool, 18 ..... .25
Tilt-Top Table, 20" by 24" top, 249A ..... .25
Upholstered Stool, 240A ..... .25

RADIO

Amateur Short Wave Receiver, three tubes, battery or 110-volt A.C. or D.C. operation, 155 ..... .25
Amplifier, Three Stage, 42 ..... .25
Beginner's Battery Receiver, 365A ..... .25
Five Tube Short-Wave Set, midget receiver with loudspeaker, A.C. or D.C., 223 ..... .25
One-Tube Receiver, battery operated, 103 ..... .25
Screen Grid Receiver, 109 ..... .25

MISCELLANEOUS

Automatic Lighthouse Night Lamp and Pelican Design Sewing Kit, 255A ..... .25
Bird and Animal Patterns, 56 ..... .25
Electric Train, Horse, and Doll House, 14 .25
Four-Treadle Hand Loom, 268A-269A ..... .75
Indian Book Ends, Alligator Toy, and How to Cut Sheet-Metal Monograms, 360A ..... .25
Paddle-Wheel Magazine Rack, Ski Repairs, and Rack for Table-Tennis Paddles and Balls, 343A ..... .25
Perpetual Star Chart, 214 ..... .25
Six Simple Block Puzzles, 65 ..... .25
Toy Lathe, Drill Press, Saw, and Jointer, 113 ..... .25
Turned and Inlaid Buffet Set (bowl and pair of candlesticks), 307A ..... .25
Wood Mosaic Serving Tray and Novelty Wooden Book Ends, 297A ..... .25

POPULAR SCIENCE MONTHLY
353 FOURTH AVENUE, NEW YORK

Send me the blueprint, or blueprints, numbered as follows:

.....

I am inclosing.....dollars.....cents

Name .....

Street .....

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(Please print your name and address very clearly)

Best cigarette I ever rolled
..give me VELVET every time
Velvet
PIPE AND CIGARETTE TOBACCO
Velvet
Better smoking tobacco
Velvet packs easy in a pipe
Rolls smooth in a cigarette
Better tobacco for both
—the MILDNESS of fine old Kentucky Burley aged in wood
—the FLAVOR of pure maple sugar for extra good taste

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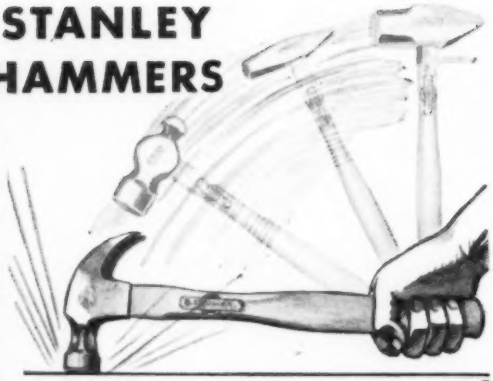
STANLEY HAMMERS



FOR EVERY CRAFT

It takes more than materials alone — or design—to make a good hammer. It's a case of "knowing how," and because they know how Stanley makes the hammers which are usually selected by top men in every craft.

"ONE HUNDRED PLUS"

Super-heat treated Chrome-Molybdenum Alloy head, *individually* tempered. The "right" handle of selected hickory with exclusive "Evertite" process to assure a permanently tight head. Claws to pull a headless brad. Unquestionably the "tops" in Nail Hammers.

No. 312 Machinists' Hammers

STANLEY TRADE MARK

Super heat treated head. "Evertite" processed selected hickory handle.

No. 233 Riveting Hammers

No. 594 Soft Face Hammer

For finely finished surfaces or delicate machine parts. Renewable composition tips are resilient and tough—will not mar the work.

Stanley Tool Catalog No. 34 describes the full line of Stanley Hammers. Write for a copy

STANLEY TOOLS

Division of The Stanley Works, 105 Elm St., New Britain, Conn.

Build These PRIZE-WINNING Projects

NEW Stanley Plan Packet 50¢

In Canada 75c

The 26 *best* of the hundreds of entries in the recent Stanley project contest. You'll want to build every one of them. Complete working plans, on separate sheets of tough paper—sent postpaid for only 50c. Send coin or stamps now for the new Stanley Plan Packet.

Construction Kits

FOR MAKING MODELS OF HISTORIC CRAFT

ONE of the reasons why building ship models is such a fascinating hobby is that there are so many famous craft that can be reproduced. For the convenience of readers we have prepared construction kits for making twenty-eight different models—models ranging from a stately and decorative galleon to the U.S. Navy destroyer *Preston*, pictured above. There are simplified models for the beginner and more difficult models for the advanced craftsman.

Each kit in the list below contains all the raw materials for making the model named. A certain amount of preliminary shaping has been done on most of the hulls or hull lifts, and the other materials are of such sizes and shapes as to make it easiest for you to transform them into their final form. Full-size blueprints and complete instructions are included.

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. MANHATTAN, 12" long..... $1.00
H. Cruiser U.S.S. INDIANAPOLIS, 12" long..... 1.50
J. Clipper SEA WITCH, 9½" hull, 13" over all.... 1.50

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier SARATOGA, 18" long..... 1.00
N. Convoy of four U.S. destroyers, each 6¼" long .75
R. U.S. cruiser TUSCALOOSA, 11⅜" long..... 1.00
U. HISPANIOLA of the book and movie "Treasure Island," 7" long..... .50
Z. H.M.S. BOUNTY, 8½" hull, 11½" overall..... 1.50
2M. Ocean freighter, 14" long..... 1.50
3M. Yacht NOURMAHAL, 8⅛" long..... 1.00
5M. Liner PRESIDENT LINCOLN, 14¾" long.... 1.50
6M. Fishing Schooner WE'RE HERE of "Captains Courageous," 9½" over all..... .75

STANDARD SHIP MODEL KITS

A. Whaling ship WANDERER, 20½" hull, 27" over all 7.40*
D. Spanish galleon, 24" hull, 30" over all..... 6.95*
E. Battleship U.S.S. TEXAS, 3' long..... 7.45*
G. Elizabethan galleon REVENGE, 25" hull, 28" over all 7.25*

(Continued on page 222)

The Show must go on!

DELAY can spell ruin to a circus. And delay can be costly and annoying to anyone—doctor, lawyer, merchant, chief, salesman, or Mrs. Jones on her way to the bridge game.

That's why so many thousands of car owners depend on the 40-point Marfak Lubrication Service and *know* their cars are always in fine running order.

Here's why: the man who renders this service has been specially schooled so he intimately knows just how to lubricate every make and model of car. Furthermore, he works with a Texaco "Chek-Chart" in front of him so he can't miss a trick—from water-pump to shackles.

As for Marfak itself—it's the toughest, longest-lasting lubricant yet made for cars—made from heavy-bodied oils so it lasts twice as long.

You'll be surprised how little this service costs—how much peace-of-mind it brings—how often it actually increases the trade-in value of your car.

• • •

TEXACO DEALERS INVITE YOU to tune in THE TEXACO STAR THEATRE—A full hour of all-star entertainment—Every Wednesday Night—Columbia Network—9:00 E.S.T., 8:00 C.S.T., 7:00 M.S.T., 6:00 P.S.T.

Let us **MARFAK** *your car*

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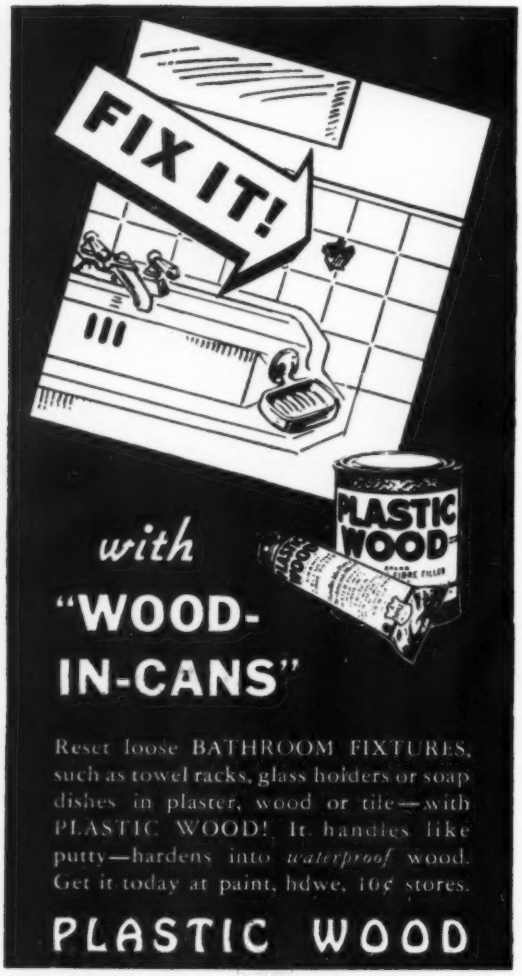
The Texas Company

THE 40-POINT LUBRICATION AT ALL TEXACO AND OTHER GOOD DEALERS



with

"WOOD-IN-CANS"

Reset loose BATHROOM FIXTURES, such as towel racks, glass holders or soap dishes in plaster, wood or tile—with PLASTIC WOOD! It handles like putty—hardens into *waterproof* wood. Get it today at paint, hdwe, 10¢ stores.

PLASTIC WOOD

PRESTO! ANYONE CAN MASTER GLAZE

LEAVES HARD GLASS-LIKE FINISH
SEALS THE PORES OF THE SURFACE
EASY TO APPLY
WILL NOT FINGER-MARK
PROTECTS THE SURFACE
NO OILY FILM AS WITH POLISH
EASY TO KEEP CLEAN
NO SMEAR OR STREAKS AS WITH WAX
LASTS SIX MONTHS TO A YEAR
SAVES YOU MONEY

Car Owners! Meet Master Glaze—the sensationally different luster for new and used cars! Not a wax—not an oil polish—not a paint!—nothing that "smears" over the surface.

MASTER GLAZE is a unique discovery—a creamy liquid—quick and easy to apply! Gives a hard, glass-like surface. Even gasoline cannot dull it! Lasts six months to a year! Amazing luster—beautiful, sparkling clean and brilliant! Doesn't finger-mark—doesn't smear! A match box full glazes an entire car. Seals the pores—protects! NOTHING LIKE IT!

AGENTS An unusual opportunity! Quick, flashy demonstrator. Big profits. Good territory. Write today!

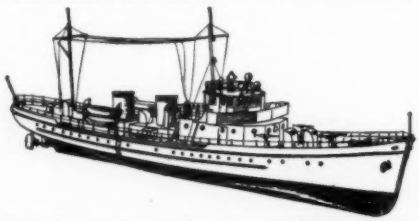
FREE SAMPLE Offer! Write now for FREE BOOKLET and FREE TRIAL OFFER. Just send your name and address. Write

MASTER GLAZE CO., 7720-64 W. Harwood Ave., Milwaukee, Wis.

Kits Teach Model Making

(Continued from page 220)

L. Farragut's flagship HARTFORD, steam-and-sail sloop-of-war, 33½" hull, 41" over all..... 8.45*
Q. Privateer SWALLOW, a Baltimore clipper, 12½" hull, 20" over all..... 4.95†
V. Clipper SOVEREIGN OF THE SEAS, 20½" hull, 26" over all..... 4.95†
Y. Trading schooner, Maine type; 17½" hull, 22½" over all..... 4.90†
2S. U.S. Navy destroyer PRESTON, 31½" long 5.95*
3S. CONSTITUTION ("Old Ironsides") 21" hull, 31" over all..... 6.50*
4S. Clipper ship GREAT REPUBLIC, 31½" hull, 42" over all..... 8.40*
5S. Coast Guard Patrol of 165-ft. type, 20⅝" long 4.95*
6S. Brig MALEK ADHEL, 20" hull, 33" over all; frame-and-plank construction ..... 9.75†



Kit 5S—A Coast Guard patrol-boat model

8S. Fishing schooner BLUENOSE, 17½" hull, 22" over all ..... 4.95†
9S. New Bedford whaleboat, with complete equipment, 14" long ..... 2.75†
10S. Confederate raider ALABAMA; steam sloop, bark rigged; 21½" hull, 28" over all..... 8.20*

MODEL RAILWAY KITS

1L. HO-gauge, Hudson-type model locomotive and tender, 14" long..... 9.95*
2L. Supplementary power unit for locomotive 1L; consists of 6-volt motor and worm and gear 4.50
3L. HO-gauge track kit. Contains raw materials for making 25 ft. of track..... 4.00*
4L. Deluxe track kit. Same as 3L except that kit contains third-rail chairs..... 6.95*

MISCELLANEOUS

7. Whittling kit with two shaped blocks for making sea captain 5½" high..... 1.50
8. Whittling kit for six different Scotties; each is 2" by 2¼", sawed to shape..... 1.00
10. Copycraft whittling kit for making one of several Hobo Hank novelties. Includes master model 5¾" high..... 1.50
12. Marionette kit for making a model of Dopey the Dwarf, 9" high. Hand-painted head and complete parts, ready to assemble..... 2.25†

Note: If you live west of the Mississippi River or in Canada, add 50 cents to prices marked with an asterisk (*) and 25 cents to prices marked with a dagger (†).

Popular Science Monthly, Dept. 59A
353 Fourth Avenue, New York, N. Y.

Please send me C. O. D. Kit.....

I will pay the postman the price shown above plus a few cents postage in full payment. (Canadian orders cannot be sent C. O. D.).

Name.....

Address.....

City.....State.....

(Please print your name and address very clearly)

If you prefer to send your remittance with this order, you save the C.O.D. charge. Remit by money order, check, or registered mail. This offer is made only in the United States and Canada. Also see note above.

"MY STORE BLEW AWAY, *with me in it!*"

E. D. CORNELIUS

STORE TAKES OFF IN TORNADO CARRIES STOREKEEPER 200 FEET

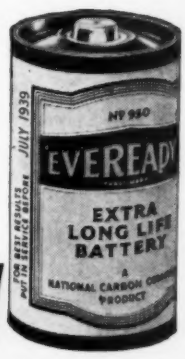
❶ E. D. Cornelius, of Daisy, Oklahoma, used to run a store near Antlers, until a tornado blew it away, *with him in it!* He writes:

❷ "At ten o'clock the night of June 9th, I was wakened by terrific thunder and lightning. I grabbed a flashlight and started pulling on my clothes. The howl of the wind became a scream. The store began to rock. An avalanche of merchandise tumbled from the shelves... *and over she went!*

❸ "Something hit me and I went out like a light—but my flashlight didn't and I still hung on to it. My store landed 200 feet from its foundations, and then went on...

❹ "...but it left me at the first stop. Neighbors who saw my store was gone started looking for me. They found me alive only because the 'Eveready' *fresh* DATED batteries in my flashlight were still working. I lay battered and unconscious on the bank of a rapidly rising stream. A matter of minutes and I would have drowned. No two ways about it, I owe my life to 'Eveready' batteries, the kind that can take it!

(Signed) E. D. Cornelius"



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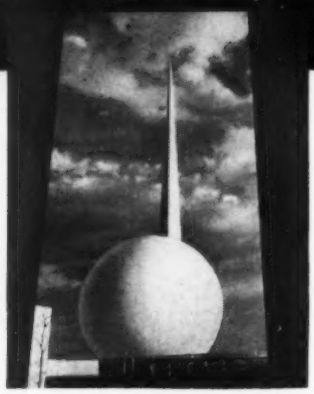

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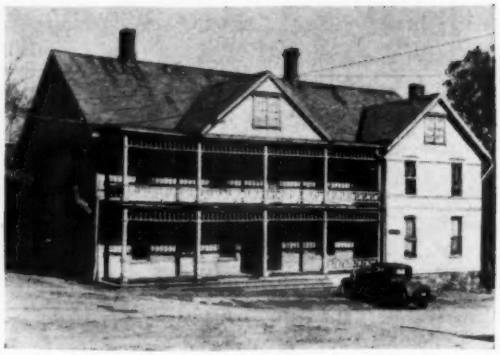

Old hotel taken with camera placed as far back as it was possible to get because of another building

View photographed from the same position but with the front element of the Tessar-type lens removed

Wide-Angle Photos Taken with Rear Half of Lens

IF YOUR camera is one of the many fitted with a Tessar-type lens, it may be made to serve in an emergency for wide-angle work. Only the rear element of the lens is used. It will be found that the lens may then be racked back a considerable distance to take in almost twice as much of the scene as when both elements are used. On the ground glass the image will be quite fuzzy at the largest aperture, but by stopping down to F/32, the center of interest will be quite sharp. The disadvantage is that the scene falls off in sharpness towards the edges, and therefore the method is not suggested for general use.—KENNETH MURRAY.

How to Give Prints a Semigloss

AN ATTRACTIVE semigloss can be given photographic prints, I have found, by squeegeeing them on a sheet of phenol-formaldehyde composition or even on the bottom of a tray of the same material.—P. N.

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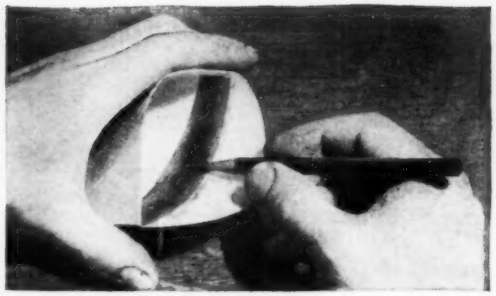
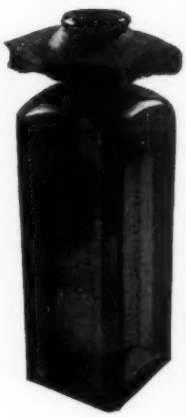


Retouching-Pencil Dust Stored in Envelopes

DUST from carbon retouching pencils may be saved for future use in retouching prints and enlargements by the method illustrated. Obtain a number of small envelopes and letter or number one of them to match each retouching pencil used. On the inside of the back of each envelope glue a strip of fine sandpaper. If each pencil is sharpened on the sandpaper in the corresponding envelope, the envelopes will collect the dust, graded as to hardness and ready for instant use.—GUY A. RAFUSE.

Sponge-Rubber Pad Protects Developer Bottles



PIECES of sponge rubber cut from a kneeling pad will protect developer bottles and other bottles from the drippings caused in pouring out the chemicals. In this way the bottles will be kept clean, and the labels will not become loose. A slit is cut in the center of each piece of rubber slightly smaller than the neck of the bottle, and the rubber is stretched over the neck.

Making Clock Hand Easily Visible

AN ELECTRIC kitchen clock with a long sweep second hand makes an efficient darkroom timer when hung near the safe light. The second hand will be more easily visible if a black strip cut from the edge of a 35-mm. film is laced on by passing the hand in and out of the perforations. A touch of household cement or even nail polish will hold the film in place.

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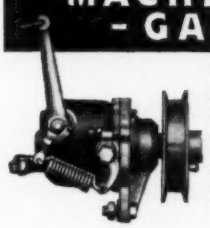

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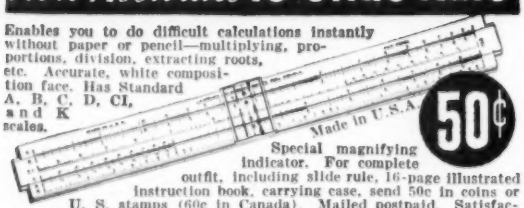

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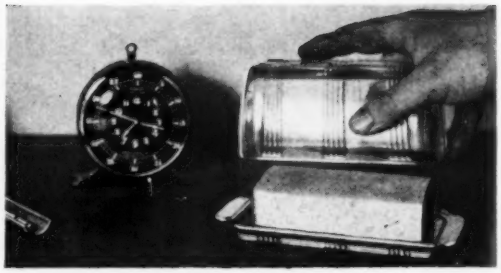


Butter Dish Holds Sponge

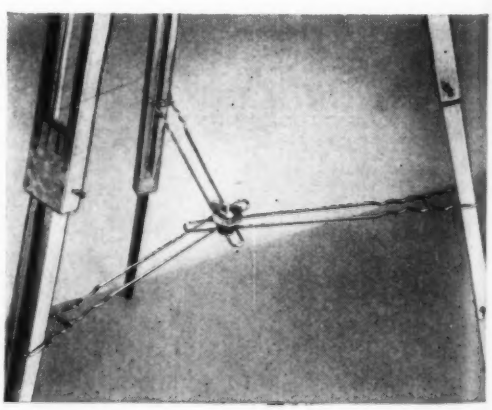
A CELLULOSE sponge may be kept pliable and dustfree in a covered refrigerator butter dish of the 1-lb. size. Each time after wiping a film, rinse the sponge and place it in the dish immediately.—HAZEL B. GIRARD.

Rigid Tripod Brace Made from Coat-Hanger Wire

THREE straightened pieces of wire from coat hangers may be converted into a strong, durable tripod brace. Bend each wire, which should be approximately 28" long, in the center to form a U about ½" wide, and form a short inward curve at the ends of each. About 1" from the curved ends, make several bends or kinks as shown below.

Shape another piece of wire about 2" long into a sort of clasp, taking care that the joint is in the center and not on the end of the finished piece. Make three of these to slide over the arms of the brace and hold them securely on the tripod legs. Assemble with a stove bolt, three washers, and a wing nut.

Tight-fitting rubber tubing may be slipped over the ends of the arms to prevent scratching the finish if the brace is used on a metal tripod.—FRANK T. CAPORAEL.



Each arm of the brace is slipped over a tripod leg, and the clasps are pushed up to tighten the wires

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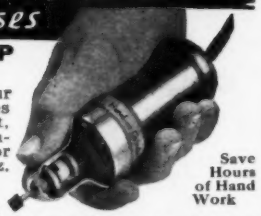

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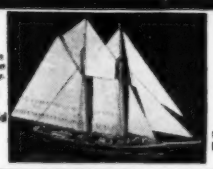

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• • •

The foundryman is the only one who knows exactly how a casting will come out, so let him check the drawing and pattern first. It is always better to play safe.

• • •

Guide posts and bearings of punch-and-die sets will last considerably longer if the posts are protected with a telescoping cover made from various sizes of thin tubing.

• • •

In a pinch, pieces of discarded ¼" square files, if properly drawn, make good tool bits.

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It is remarkable how much can often be saved by slight changes in design. One manufacturer recently reduced the cost of a certain machine part from $1.40 to 78 cents by modifying the design a little, using standard-shape stock, and resorting to three welds.

• • •

If you haven't done much knurling, practice on scrap before attempting a real job.

• • •

When a surface to be cylindrically ground is within the face capacity of the wheel, give the infeed method the preference. That is the best way to obtain all-around precision.

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A small, rigidly supported abrasive stick will dress a grinding wheel surprisingly well in the absence of anything better.

Pipe Coupling Substitutes for a Reducing Bushing

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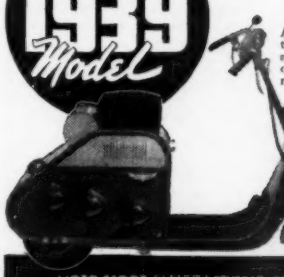
New 1939 Model

Moto Scoot



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Don't miss all of the enjoyable Spring projects. Driver can turn your dream shop into reality within a few days, or make your present shop into a "dream" with new 1939 Driver Tools like this—

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DRIVER *Engineered* POWER TOOLS

King of the Whittlers

(Continued from page 116)

and there were always plenty of buyers even during the worst years to take every piece he could carve, at good prices.

"Andy" could roll up his sleeves, break out his tools, and ply his unusual trade practically anywhere on the face of the earth. His tools are fewer and less expensive than those of a jackleg carpenter. All he needs is a workbench, a vise, a coping saw, a set of three chisels, and some knives ground from old-fashioned, straight-edge razors. He buys kiln-dried basswood in the form of four by ten-inch planks. These are sawed into blocks upon which he makes the penciled outlines of the figures he intends to carve. He'll get a cowboy out of a piece two by four by ten inches, or a bronco or steer from a block four by ten by ten inches. A twenty-foot plank will last him more than a month, and with the work of those big hands of his added to it, it retails for thousands of dollars!

After his figures are carved, they have to be finished in color. To do this, "Andy" uses oil colors applied with camel's-hair brushes. His paints are slightly thinned with gasoline to carry the pigments well into the pores and grain of the wood. By the judicious use of color he gets a further heightening of the caricatures he has carved in wood. Color is part and parcel of the cow country, and he knows the precise shades for enlivening every character he carves.

The knives which "Andy" considers the essential tools of his trade are as distinctive as the figures he carves with them. He pulls the handle off an old razor, sets the stem in glue between two hollowed sticks, and wires the assembly together.

"But I should think you'd have to raid the museums to find enough old-fashioned razors," I commented, as "Andy" explained the tools of his trade.

"No," he replied. "An adequate supply of straight-edged razors is one of the advantages I find in being within striking distance of Hollywood. There are more cowboys employed in the motion-picture industry than on all the cow ranches in Colorado—and those fellows have tough beards! They still talk about the city dudes who shave with a hoe, and they'll have nothing to do with those new-fangled, electric 'sheep clippers.' Anything that suggests a sheep is poison to a cowman. Well, most of those chaps are homesick to get back on the range, so my place is a sort of hangout for 'em; they like to come out here and swap yarns. They bring me all their old razors, and they bring 'em a lot faster'n I can wear 'em out."

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Speed of 25 to 27 thousand revolutions per minute without vibration makes it possible to do all kinds of fine work such as **carving, grinding, engraving, drilling, routing,** etc., with a Dremel Moto-Tool and to do it in a jiffy. Two models to choose from—No. 1 as shown, only $9.85 and No. 2 for heavier work only $16.50.

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Make deliveries for less! 400 lb. cap'y. Greater economy, safety, beauty, convenience.

5 HANDSOME MODELS FOR ALL PURPOSES! Standard and De Luxe 2-wheel AUTO-GLIDE for sport, business, school. Kari-Pac and Glide-Kar (left) for deliveries.

WRITE! or ask dealer for illustrated booklet, full details, low prices, NOW!

DEALERS: Write for special offer, facts about rental profits!

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It's time right now to clean out your car radiator. Clean out anti-freeze, rust, scale and lime deposits all in one simple operation. Pour 10c worth of Sani-Flush in the radiator (25c for the largest trucks and tractors). Run the engine. Drain. Flush. Refill with clean water. The job is well done. *Follow directions on the can.*

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Real Quality Tools
Designed, manufactured and guaranteed by SpeedWay, for 30 years leading manufacturers of industrial drills, these are really fine tools, correctly designed, correct speeds, genuine high torque drill motors. Small, handy, powerful; 1000 RPM—drill handles to 1/4" in steel. Die cast handle and gear housing, $7.95. Grinder operates at 20,000 RPM (high speed is essential for good grinding) with collets for 1/8" and 3/32" arbors, $5.95. No. 250 KIT, both drill and grinder with 5 accessories in steel carrying case $14.95. Complete line of accessories and drill press stand. Write for Circular. Dealers Write.
SPEEDWAY MFG. CO.
1824 S. 52nd Ave., Cicero, Illinois
DRILL $7.95
GRINDER $5.95
SET $14.95

Mystery Island

(Continued from page 75)

French Revolution had occurred only a few years before 1795, when the three boys from the mainland of Nova Scotia had made their discovery of the sawed-off limb and the sunken spot in the sod on Oak Island. History records that when Louis XVI and Marie Antoinette fled from Paris, they took the fabulously valuable crown jewels with them. At Varennes, where the royal fugitives were captured, a lady-in-waiting is said to have escaped. She is believed to have been carrying the jewels at the time. Later, she is reported to have been traced to Louisburg, Nova Scotia. This frontier city, a refuge for exiled French nobility and known at the time as "the Paris of the western world," was within easy reach of Oak Island.

Since the days of the French Revolution, nothing has ever been heard of the gems of Louis and Marie Antoinette. The fact that no record exists of any of these jewels having appeared strengthens the belief that they were secreted some place where they have remained safely hidden to this day. Where? On Oak Island? Nobody knows. But it was on this supposition that the 1909 treasure hunters based their hopes.

Other theories cover a broad range. In gathering material for this series of articles, I have talked to a number of men closely associated with various expeditions to the island. One was sure that Blackbeard the pirate had buried his loot on the island. Another was equally positive that Captain Kidd himself had ranged up along the eastern coast of North America in the *Adventure*, and had sailed into the maze of Mahone Bay to cache treasure beneath the curious elmlike oaks of one of the islands.

Charles B. Driscoll, noted authority on pirates and buried treasure, advances a far different theory in his book, "Doubloons." He believes that the money pit and its mysterious sea-water tunnel were made by early Norsemen who crossed the Atlantic in their Viking ships long before the coming of Columbus.

Whatever the true answer, the 1909 company left the island with the question as shrouded as ever in mystery. Early in the fall, the expedition packed up its diving apparatus and its machinery and sailed for New York. Once again, the enigma of the island had withstood assault.

Nearly two decades passed. Then, on May 8, 1928, the New York "Times" published a feature article on the mysterious money pit of Mahone Bay. Twenty-five miles west of

(Continued on page 236)

● Every fisherman will want this book! Written by Cal Johnson, noted angler. Tells tried ways, methods of night fishing for bass, wall-eyes, other fish. How, when to cast or troll after dark. Frogging. 72 pages of night fishing thrills. Shows the Powerlite and other Delta electric lanterns. *Write for this book. Free!*

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this summer. Enjoy the double pleasure of making and using it. All you need to start with is an old auto generator; we'll show you how to do the rest. A dime brings you complete plans and a valuable catalog. The finished job is Easy to Operate, Clean, Silent, Lightweight, and will run for 8 to 12 hours on a 6-volt battery. Its variable speed control makes it fine for fishing and trolling. Send us your dime and get started right away.

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1/8" Scale reproduction of Sir Malcolm Campbell's famous "BLUEBIRD" 14" long. 2" wheels. Colored Blue with Aluminum trim. Black details. Kit is complete all parts materials ready to shape and assemble. **60c**
Accurate full size plans. Postpaid.....
Circular of other "CHAMPION" MODEL KITS FREE.
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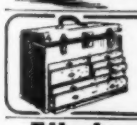

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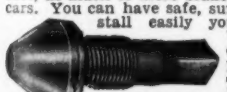

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A MYSTERIOUS DISCOVERY
SAVES UP TO 30% on GASOLINE
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Constructed of six parts fused into a single unit, adjusted and *sealed at the factory*. Easily and quickly installed by anyone in a few minutes.

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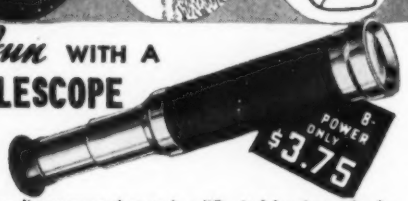

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WOLLENSAK

Mystery Island

(Continued from page 234)

New York, an engineer, looking over his Sunday paper, noticed the article. As he read on, he became fascinated with the century-and-a-quarter-old riddle of Oak Island. The story of his subsequent activity, of his 6,000-mile search for clews, of his recent amazing discovery, and of his plans for raising the treasure, all will be told for the first time in the final installment of this series appearing in the June issue of POPULAR SCIENCE MONTHLY.

Snail's Tool Kit Shown by Your Microscope

(Continued from page 197)

the balsam hardens, to spread the tongue more uniformly. You can make a simple clamp from springy wire to do this; or set small lead weights on the cover glass while the slide lies on a horizontal surface.

The lingual ribbon, you will find by examining with your microscope at magnifications ranging from the lowest power up to several hundred, consists of a series of teeth set in rows. The sizes, shapes, and arrangement of these teeth vary widely, but are always beautiful. In *Limnaea stagnalis,* for instance, they are arranged in geometrical rows more beautifully than any human hand could do the trick, and are as uniform as the teeth on any man-made file.

The lingual ribbon of a snail is used exactly like a file or rasp to grind into small particles the food, such as leafy tissue, which the jaws scrape into the mouth. Some ocean-going snails use their rasplike tongues to cut holes through the shells of other animals.

POPULAR SCIENCE Question Bee

How did you fare in the Question Bee on page 134? In the list below, letters indicate the correct answers to the numbered questions. Check your list against it and give yourself five points for every one you got right. A total score of 75 to 85 points is good; 90 or better is excellent.

1. b	5. c	9. c	13. c	17. c
2. b	6. c	10. c	14. a	18. b
3. c	7. d	11. d	15. c	19. c
4. a	8. b	12. b	16. a	20. d

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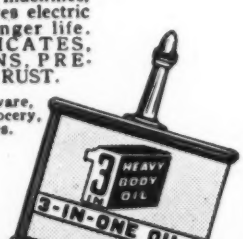

3-IN-ONE OIL

Chemistry of Fuels Seen in Easy Tests

(Continued from page 203)

Above all, the height of the flame and the length of time that it burns must be the same. To judge the amount of sulphur burned, the professional chemist will weigh the precipitate of barium carbonate upon an extremely delicate analytical balance, while you can make only a rough estimate by observing the relative opaqueness of the solution. Therefore this experiment is not intended to serve as a test of high precision in a home laboratory, but, rather, to give you an interesting insight into the way that professional tests of the kind are actually made.

It is interesting to note that the coke you made in your miniature gas works, described at the beginning of this article, is still a useful product. You made it much the same way it is made commercially in large quantities as a fuel. Remember that your "oven" was air-tight, preventing oxygen in the air from combining with the heated combustible. Then you removed the heat and allowed the coke—almost pure carbon—to cool. As coke, it now needs only the presence of oxygen in the air and the administration of flame to ignite it in a furnace or a fireplace.

Radium from the Ocean Floor

(Continued from page 54)

dwindling supply of the essential metals mined on land. One expert estimates that nearly all known commercial deposits of copper and a number of other "base" metals will be exhausted in 100 years, and most of them in less than half that time. Another authority points out that, except for oil, no major source of minerals has been discovered in Europe since 1850 nor in the United States since 1910. As existing deposits run out, prospectors will have to scratch the earth's crust for lower and lower grades of ore. Just to mention one item, they will have a hard time finding enough tin for the staggering total of 12,000,000,000 tin cans that Americans alone use annually. But the bottom of the ocean, Dr. Piggot's experiments suggest, may hold incalculable stores of needed metals—enough to last for centuries to come.

Moreover—an interesting side light from the viewpoint of international politics—these deposits beneath the high seas will be the property of no particular nation. They will be free to all, the "haves" and the "have nots" alike, and "marine mining" may some day be a strong factor in keeping the world at peace.

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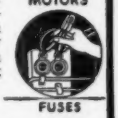

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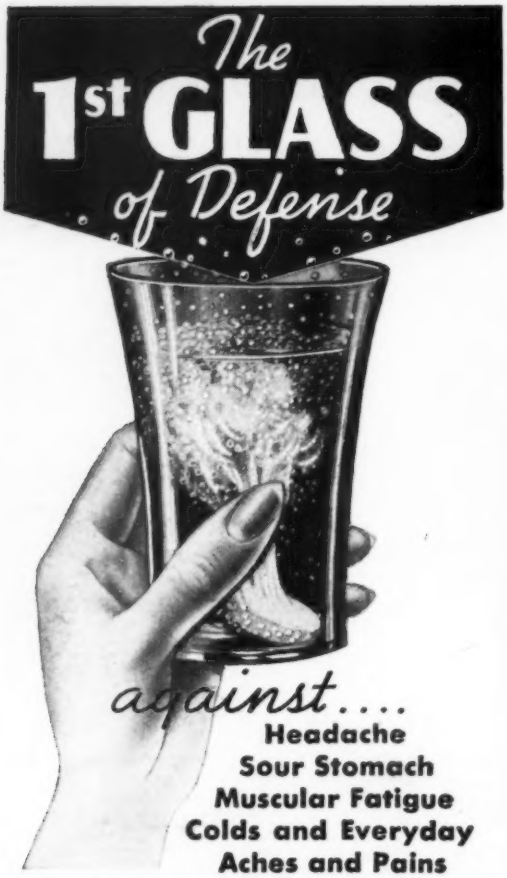

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World's Smallest Motors

(Continued from page 93)

so delicate that Arden must cut and drill to within 1/10,000 of an inch. He has an amazing capacity for careful work and only one part of his little motor had to be remade.

Fitted together—with the high-chrome molybdenum cylinder and piston, the duralumin crankcase, and the platinum-quartz spark plug all in place—this tiniest motor measures only one and one-sixth inches in height, five-eighths of an inch in depth, and seven-sixteenths of an inch in width. To protect it from damage, Arden carries it about in a spectacle case. The gasoline tank, looking like a metallic dewdrop, is approximately three-tenths of an inch in diameter. It holds four drops of gasoline mixed with oil. Arden "fills 'er up" with a medicine dropper after the fuel has been strained through a triple filter paper to remove the last traces of solid matter. The jet through which the explosive fuel enters the cylinder is so small that a magnifying glass is required to see it clearly. On one filling of the tank, the engine will run for four minutes, spinning the propeller 72,000 times.

This Lilliputian engine is far from being a freak. By increasing all its dimensions in proportion, its scale drawings could be used as the basis for a full-size motor. Making tests with a cathode-ray oscillograph and other delicate scientific apparatus, Arden has discovered an astonishing fact. His midget is more efficient for each cubic inch of cylinder space than are the best two-cycle racing motor-boat engines of today. By reducing the strength of the various parts, Arden could have cut thirty percent from the weight of his tiny power plant. However, throughout his work, he has striven for scientific efficiency as well as minuteness. His products are more than oddity machines; they are strong, well-constructed power plants based on sound engineering practice. As a consequence, Arden has produced innovations which can be applied to full-size engines as well.

Today, he has gone far on the course he set for himself so many years ago in front of the booth at the sportsman's show. His latest mechanical midget weighs less than 1/250 as much as the Herring engine which started him on his labors. But, even now, he is planning another and tinier power plant, a semi-Diesel engine of radically new design. With this flyweight mechanism, Arden expects to attain his ultimate goal. This is a gasoline-driven airplane which will weigh, complete—motor, plane, and fuel—less than a single ounce!

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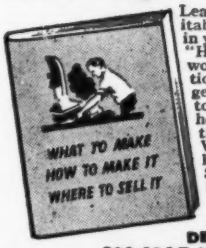

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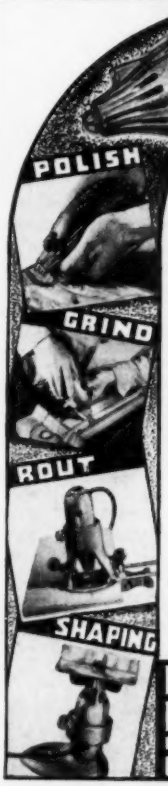

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Gus Gives the Low-Down on Engine Varnish

(Continued from page 140)

wouldn't start for me, but would start for Harry."

"The answer to that puzzle," Gus told him, "is that the engine cooled off for an hour or so between the time that you couldn't start it and Harry did start it. If varnish makes an engine stick so badly that you can't turn it over with your starter or even by towing the car with the clutch engaged, it's usually after you've left the engine idling at the end of a drive. Why, I don't know. That's just the condition you had when you left your engine running while you went into your house. You got a break when that old tow rope of George Nelson's parted. I've seen engines stuck so tight that something busted when you used enough force to turn them.

"After an engine that has stopped that way has stood for an hour or so, you often can get it running without any trouble—and, again, no one seems to know exactly why. It may be that the varnish loses some of its stickiness when it has cooled, or perhaps the cooling of the engine results in contraction in some of the parts that increases their clearance.

"Well, Jack, I'll get at your job first thing in the morning, and I think I'm safe in promising to have your car ready for you by this time tomorrow afternoon."

When Gus Wilson says "I think I'm safe in promising" a job, it's as good as any man's guarantee, so Simpson's car was ready for him to drive away when he called for it the following afternoon.

"I suppose that I'm in for plenty of grief with this bus, now that that darned varnish has started forming," he gloomed.

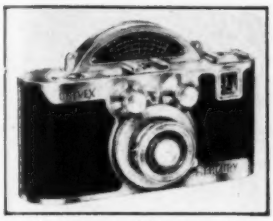
"No, I don't think that you'll have any more serious trouble," Gus assured him. "But, if you don't mind my saying so, you'll have to put a little more thought into your driving than you usually do. As a general thing, it is only in an almost-new engine that enough varnish forms to cause serious trouble. I managed to get your engine pretty-thoroughly cleaned out, but you'll have to be on the lookout for warnings that varnish is forming again. If you notice any symptoms of sticking valves, bring the car in right away, so that I can clean them. Probably I'll have to do that at intervals until the clearance of the engine parts has been increased by wear."

"Somehow," Simpson said, "I feel guilty about this thing. I don't know what I did that was wrong, but I must have done something wrong. There *(Continued on page 244)*

New 1/1000th-of-a-second Speed Camera Challenges World's Finest!

$25 All-American Made Model Competes With Most Expensive Foreign Makes!

New York, N. Y., May 1 . . . Bursting like a bombshell on America's millions of camera fans comes the announcement of the first 1/1000th-of-a-second Candid Camera ever to be produced in America—The UniveX Mercury, priced at only $25!

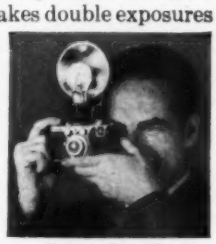


"The Camera of Tomorrow"

To the man who knows cameras it seems almost unbelievable that such sensational features, such speed, performance and refinement of precision-built detail could be found in anything but the most expensive foreign-made cameras. Dealers themselves say "Here is the first American candid camera that successfully challenges $100 to $200 foreign makes!"

Not only does the amazing Mercury offer the lightning speed of 1/1000th of a second—heretofore associated only with candids built abroad, but, because of its built-in photo flash synchronizer switch, it literally turns "night into day"—makes superb nighttime shots that are true, sharp and clear. It is equipped with a Tricor F 3.5 lens, which unlike any other lens on American speed cameras, has a 35 mm. focus and thus gives 150% more depth to Mercury photos.

In addition, the new Mercury offers an automatic film transport which makes double exposures impossible; an accurate all-metal focal-plane shutter; built-in exposure calculator; built-in parallax correcting view-finder; 17 focus graduations from 1½ feet to infinity.



Built-in Photoflash For Nighttime Shots!

The ingenious and convenient "instrument panel" arrangement of all controls makes for speedy and accurate adjustments. The sleek, handsome exterior is finished in polished aluminum and genuine leather.

Equally sensational is its film economy! Only the Mercury uses the fast, economical UniveX 35 mm. film (18 and 36 exposures) that cuts negative costs approximately 60%!

Dealers suggest that you place your order at once so that reservations may be made for you from the next shipment, send for FREE illustrated booklet! Dept. M-11, Universal Camera Corp., New York, Chicago and Hollywood.

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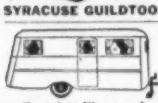

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Paramount Products Co., Dept. 5C, 48 West 48th St., New York

Gus Gives the Low-Down on Engine Varnish

(Continued from page 242)

must be some reason for that varnish forming on some engines, and not on others."

"There's a reason, of course; there's a reason for everything," Gus said. "But we don't know all the answers yet, and the reason for varnish forming is one of the answers that we don't know. But we do know that lubricating oil has something to do with it. There's no reason for you to blame yourself—unless you have been using oil of a type not recommended by your car's maker."

Jack Simpson looked as guilty as he said he felt. "Hey, there!" Gus said. "What about the oil you've been using?"

"To tell you the truth," Simpson admitted, "I was out of town when my mileage got up to the thousand mark, so I just drove into a service station and told the fellow there to drain her out and fill her up again."

"Well after this," Gus said sternly, "you come in here and we'll make sure that you get the type oil that is right for your particular car. I'm not saying that using oil of poor quality or of the wrong type made your engine a sticker. But I *am* dead certain that using good oil of the type recommended by a car's manufacturer is your best safeguard against the formation of varnish that might make it stick again!"

Mysterious Car Troubles

• •

PRIZE WINNERS

Martin Bunn recently invited readers who are garage mechanics to send in letters telling about the most mysterious car trouble they've ever solved.

Many readers submitted unusually fine letters. In the opinion of the judges, John M. Knobbe, garage mechanic of Spearville, Kan., submitted the best letter and was awarded the first prize of $50. The six other prizes were awarded as follows:

SECOND PRIZE, $25
E. F. Hawes, Attleboro, Mass.

THIRD, FOURTH, FIFTH,
SIXTH, and SEVENTH PRIZES, $5 each

Lloyd Hughes, Englewood, N. J.
Thomas Forsyth, Downey, Calif.
James Stukel, Laurium, Mich.
Robert Gazzale, New York, N. Y.
Pete Ezbe, Beallsville, Pa.